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JOURNAL *of* EDUCATIONAL RESEARCH

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TECHNIQUE OF THE PUBLIC SCHOOL SURVEY[1]

J. B. SEARS
Stanford University

DEVELOPMENT OF THE SURVEY MOVEMENT

Origin of the survey idea.—The survey movement in education began in 1910 and 1911 with surveys of the school systems of Boise, Montclair, Baltimore, East Orange, and Boston. For several years previous to this date cities and states had been subjecting their schools to the careful scrutiny of lay commissions, while in our universities a quantitative terminology was slowly being introduced into educational studies. These lay investigations and scientific studies were the immediate precursors of the educational survey movement.

The forces which had brought these several activities into existence were the same forces that had brought the business expert or the efficiency engineer into business and industry. The taxpayer had begun to ask, "what do I get for the dollar I have invested in schools?" People everywhere had begun to criticise the management of the schools, the curricula offered, and even the aims toward which the schools were working. Meantime students of education were at work on the development of a technique for the scientific study of educational problems.

It may be shown that the survey movement has made two important contributions toward the development of a science of education. One is in the extensive and clear analysis it has made of educational facts and situations. The other is in the additions

[1]This paper was presented at the Conference on Educational Research and Guidance held at State Teachers College, San Jose, California, May 19 and 20, 1922.

it has made to the actual methods and technique of educational investigation.

To substantiate these statements one only has to run through the survey reports. Nowhere before this do we find such clear and such well-reasoned statements of educational aims. And the same may be said with reference to the functions and character of buildings, curricula, supervision of health, finance, organization, and administration as well as of many lesser topics. On the side of technique the survey movement has made substantial contributions to tests and measurements, having worked out and demonstrated the use of quantitative standards in a wide variety of places in education, and having brought to light a goodly number of working principles with reference to which teaching, administrative, and supervisory processes may be directed. Besides these specific contributions it has furnished a most valuable general stimulus to scientific work in education.

Dominating purposes in the survey movement.—After a little more than a decade of development and of service to the public we may properly ask, what have we learned about surveying? The work has succeeded in the sense of having convinced the public of its practical worth, and it is so bound up with the movement which is devoted to the scientific study of education, both in its workers and in the purposes and character of its work, that its value in this direction is also obvious.

As we look over the brief history of the survey movement, it is possible to distinguish three main purposes which have dominated the work almost from the beginning. The first and foremost of these purposes has been a purely practical and utilitarian one, viz., that of helping the schools to a better practice. Back of this purpose were the demands of the people for an accounting and the earnest desire of our leading educators to bring the schools of the country up to better standards.

The men who have really directed the survey movement have been scientific men, men who have not only conceived the highest achievement of any science to be its ultimate issue in benefits to mankind, but who have realized that such benefits can come only in proportion to the scientific results that are achieved. To make

education scientific, therefore, was also their ambition, and in the school survey they saw the opportunity to learn new things about education and to apply, and perhaps discover, new methods of study. A second purpose, therefore, has been the gathering and analysis of new facts, or the increase of our knowledge about educational phenomena; and a third purpose was to apply and to develop the scientific technique essential to the building up of a science of education.

Without these subsidiary purposes it is doubtful whether the best educational leadership could have been so largely drawn into the movement as it has been. If then, some of the reports of surveys have been over-technical in form, we should feel no particular surprise, and perhaps not too much regret, since it has meant at most only a wrong emphasis and a more indirect attack upon the practical problem and, to some extent, these have been offset by a relatively larger scientific contribution.

Development of the proper functions of a survey.—What are some of the fundamental facts and principles with reference to which the survey movement and the individual survey are to be directed? What has "survey" come to mean; what may the survey movement hope to accomplish; and what particular principles and technique have been developed for this type of work?

Very early in our survey experience the question arose as to how far a survey should go in uncovering graft, dishonesty, and unfairness, as distinct from other types of inefficiency. Should a survey subpoena witnesses, conduct hearings, and try to place the blame for inefficiency or crookedness upon the particular persons found responsible, or should it stop with a clear statement and explanation of the inefficiency, leaving to the board of education or other properly constituted authorities the task of placing the blame upon persons or of bringing the matter to the attention of a grand jury?

In spite of opportunities no important survey assumed the responsibility for exposing graft or for referring by name to those responsible for inefficient service. It was early declared, and the position has consistently been maintained, that such work was the function of grand jury or other special investigation,

and not the function of a survey. This is a significant distinction since it has removed from the realm of the survey a large amount of work of a purely negative type and forced upon surveyors the necessity of finding a positive and constructive function to perform.

A second question that had to be settled was, how far shall the survey go in outlining a program of future action for the schools. Was it enough to describe and explain what was good and what was poor about the schools, or should the survey show how to do away with what was poor and how to replace it with something better? To settle a question like this was not easy, and there appears to have been difference of opinion. Many of the early reports, and not a few since then, have been quite largely descriptive in character with special emphasis upon the weak points of the system in question. But this is not strange when we consider how little we had in the way of standards or even of authoritative opinion on what a city school system should be like.

At the beginning of the survey movement, studies of retardation were still in an undeveloped stage, pedagogical tests were just being made, but were hardly available for use in a survey, there were no group mental tests, and practically no standards available for use in the study of buildings and equipment. Not much was available as a basis for judging staff, curricula, organization, supervision, and administration; and only a little had been done in the comparative study of school costs. Without standards, without an adequate knowledge of practice over the country in any of these major fields, it was not easy to outline a constructive program for the future.

In the face of these difficulties, however, it soon became evident that a survey must project into the future if it was to be useful. In the light of our experience to date, then, we may define the functions of a survey about as follows: The function of a school survey is to apply the best available technique in the study of a school system, with a view to revealing the character and the extent of its efficiency, and with a view to showing how the best possible results may be obtained. This calls for analysis

and measurement, for the use of exact methods, for the application of principles and quantitative standards wherever possible. It calls for description and for interpretations, for a statement of facts, whether they are favorable or unfavorable, and for constructive proposals as to what ought to be done next and how to do it.

Early lack of survey technique.—Having settled upon a proper meaning, or function, the survey turned naturally to the question of how to accomplish its purpose. This immediately raised the question of how extensive a survey must be in order to afford an adequate basis for outlining a future program. It also raised the question of whether a single feature of a system could be surveyed separately. Practice soon answered this latter question in the affirmative. Numerous studies of "progress of children through the grades," of "curricula," of the "efficiency of pupils in their studies," and of "finance," were undertaken as surveys of these aspects of the schools.

But how to measure the efficiency of a school system as a whole was a difficult question. When the technique for studying retardation had reached a fairly satisfactory stage, retardation studies were heralded as real measures of the efficiency of school systems. One has only to read the early literature on retardation to be convinced that the development of this one piece of technique was a very striking thing in the recent history of education in this country. He may also be struck by the credulity with which the rather crude interpretations of the results of retardation studies were accepted.[2]

At the outset there were almost no instruments for making exact measures of the processes, machinery, or products of education; and no great skill had been developed in the use of comparative methods. The practical demands of the survey disclosed the fact that what education had in the way of facts, methods, and technique had been developed and, in the main, adapted for use in the laboratory and classroom. We had

[2]See: Volkman, Hilda, and Noble, Isabel, "Retardation as indicated by one hundred city school reports." *Psychological Clinic*, 8:75-81, May, 1915. Presents a study of the history of the influence of retardation studies on city superintendents' reports.

worked largely in isolation, and with reference to the demands of logic. Now we were asked to work in the open field, in the midst of the tangle of practical conditions, and with reference, not only to logic, but also to "what will actually work." It was clear, therefore, that the survey had before it the task of building up a technique of its own.

Survey Technique

The meaning of technique.—By survey technique we mean the particular methods and machinery essential for the carrying on of a survey. It includes all the various instruments and devices used to detect the presence or absence of a thing, or to determine the amount of the thing present, or to determine causal or other relationships between things found. It includes principles, axioms, plans, and opinions. It also includes the methods by means of which these instruments and devices, these principles, axioms, plans, and opinions, are brought to bear in determining the aim, the extent, and the plan of the survey, as well as in carrying forward the process from its inception to its final conclusions and recommendations.

It is not our purpose to trace the history of the development of this technique, but rather to discuss briefly some of its more important aspects as they have thus far been built up. These we shall consider as nearly as possible in the order of the need for them in making an actual survey.

Defining the aim of a survey.—First of all, the survey must have a definite aim. This seems a very trite statement, yet if one has read the survey literature, one will realize its pertinence here. Obviously the function which the finished survey is expected to perform must provide the aim which directs the surveyor in his work. Yet, as our survey reports show, it is very easy for the surveyor to be overwhelmed by the academic or scientific possibilities which at once appear in the study of a school system. Accordingly we should set down as a working principle to be kept in mind that *the aim of a survey must be determined by the functions which are finally to be served by the*

completed task. We should also add, that the plan of procedure in the study must be drawn with careful reference to these aims.

The relation of the aim to the plan of work.—The relation of aim to working plan suggests the second problem. The difficulty here lies in the fact that we must determine what facts, processes, and conditions to study, what principles, methods, devices, and instruments to apply in the attainment of the aim, and how to organize our procedure with respect to a plan of operation. The broader and more comprehensive the aim, naturally, the more difficult it is to devise a plan of procedure that will unravel the many complicated relationships with which the survey must deal.

To the writer there seem to be four main steps or problems in any complete study of a school system. First, the community's educational needs must be defined. Second, the community's capacity to provide for its needs must be ascertained. Third, the present educational facilities must be evaluated in the light of what is needed and in the light of what the community is able to pay for. Fourth, a constructive program of procedure must be worked out with reference to such of the corrections and expansions recommended as the community is able to provide.

In a sense these are four distinct pieces of investigation, each of which must be carried out in any complete survey. It would be possible to carry them out separately and in the order here presented. No survey, however, has done this; and the reason for this is clear. To locate some of a community's needs one would of necessity make many studies almost exactly like the studies necessary for measuring the efficiency of schools as they exist. Furthermore, in reporting the survey such a plan would involve repetition at so many points that it would not be economical. The point to emphasize here is that these are four functions to be performed in a survey. They suggest not only the main divisions of the aim of the survey, but also the logic of the plan of work. In the latter sense they stand as a constant check on every step in the study. If the above principle for selecting the aim of a survey is our first piece of technique then the plan here suggested is our second piece.

What is the technique essential to the carrying out of these four lines of study? Since the character of the study determines the kind of technique, we shall undertake to sketch out in very brief outline a plan by means of which each of these four ends or functions may be attained. By this method the technique will be discussed in connection with the function it is to perform in making a survey.

Problem one: How to determine a community's educational needs.—In considering, first, the technique for determining a community's needs for education we may lay it down as almost axiomatic that *a community's educational needs are determined by the character of its own culture.* The full significance of this axiom will not readily occur to any except scientifically trained educators. Consequently its use in surveying is a much more technical matter than is its mere recognition as a self-evident truth. A people's economic, political, social, aesthetic, moral, physical, and intellectual interests, ideals, and activities go on together. Change in any one of these will produce some change in all the others. If a high type of culture is the aim then what we do in education must have reference to all the elements that together constitute what we call culture or civilization. It is in the light of possible corrections, expansion, and enrichment in all these lines that educational needs must be defined.

Educational needs must be considered from the standpoint of extent, of kind, of quality. We need to know how many buildings, how many teachers, how many courses; we need to know what kind of buildings, courses, equipment, organizations; and we need to know what degree of excellence in all these things it is best to provide. What facts about the community do we need, what instruments of measure may we apply and how shall we interpret our findings?

If education is to have respect to the social, economic, physical, aesthetic, moral, and intellectual life of the people, then our facts will be drawn from these fields. If the application of the above axiom in the determination of needs is step number one in our technique, then step number two would be the selection of a proper basis for judging what facts to select. Since our

needs are both quantitative and qualitative in education, we shall need to reveal the quantitative and qualitative aspects of these many features of our culture if we are to set up a complete picture of our needs.

Without pretending to present the full line of reasoning upon which a selection should be based, I shall merely attempt to outline briefly the facts that are needed, to indicate the sources from which they may be drawn, and then to explain how these facts are to be treated.

Materials and Sources for a Survey of a Community's Educational Needs

I. Data needed:
   1. Carefully drawn maps showing:
      a. Size of district.
      b. Main features of its physical and industrial geography.
      c. Location of public buildings, parks, and playgrounds.
      d. Natural population centers.
   2. Information about the population.
      a. Extent of population through a period of years.
      b. Racial composition.
      c. Age and sex distribution.
   3. Information about literacy.
   4. Information about occupations.
      a. Number and kinds.
      b. Workers in each.
      c. Sex and age of workers.
   5. Public enterprises.
      a. Government.
      b. Industrial or commercial activities.
      c. Provisions for social, intellectual, and aesthetic interests.

II. Sources of information:
   1. National and state census reports.
   2. Municipal directories.
   3. Official records in offices of city auditor and engineer.
   4. Chamber of commerce literature.
   5. Educational reports and records.
   6. Historical materials.

Our purpose is to arrange these facts so as to present a clear picture of what a school system should do to correct weaknesses or to expand and enrich the various aspects of community life. By the maps we can detect natural attendance barriers, such as

streams, bad crossings, and heavy traffic centers. We can thus show any existing need for reorganization or extension of attendance district boundaries. We can also see where to locate new buildings in order to utilize parks, playgrounds, and museums in connection with instruction. From our population data we can see about the rate at which school facilities must be expanded to meet future needs; and from the same source we may detect certain special curriculum needs, such as the adult education required by foreign groups. We can see by our age distribution the extent of the school population. By our literacy facts we can see the need for extension, Americanization, and adult education. From our occupational data we can see clearly the economic background with respect to which attendance, special courses, types of special schools, and indeed the entire curriculum and management of the schools may be worked out. Information as to the kinds of occupations and the extent to which they are available for boys or for girls is basic as an index to educational aims. Facts about the local government in connection with facts about race and industry are suggestive with reference to the teaching of history and civics, and with reference to the general social life of the schools. Municipal industries ought to be used as educational laboratories for the youth who are to direct these enterprises a few years later. Facts about the city's interest in beautiful streets, buildings, and parks, in music, libraries, and museums afford a basis for defining the community's needs for training along aesthetic and public-enterprise lines. These are but the broadest lines of school policy. By pursuing our study in some detail, community by community, within a city or county, we may arrive finally at the size and character of buildings and of classrooms, the character and extent of equipment for playground, library, laboratory and classroom, the number and kind of teachers, and so on to the end of greater and lesser needs for amount and kind of education.

The above are but samples of information, or hasty views, from the rich picture of educational needs that may be obtained from these facts when they are properly organized. Some of these are facts as to quantity or extent of educational facilities

needed, while others reveal the particular character or quality of these facilities. The basis of our choice of data may be defined by the following principle: *Educational need depends upon such facts about a community and its life as will reveal the extent, condition, character, and tendencies of its social, political, economic, intellectual, aesthetic, and physical life.*

A third step in our technique has to do with the instruments, methods, and devices to be used in assembling and classifying these data. This step is relatively simple. It calls for tabular and graphic presentation of facts in isolation and in such serial and comparative manner as will reveal changes associated with the passing of time, and the size or extent of the phenomena in question in comparison with like facts in comparable communities elsewhere.

This technique is the most exact we have for measuring such factors as we are discussing at this point. We have no precise formulae for prescribing the number of new educational units (units of buildings, units of equipment, units of curriculum) called for by the addition of a unit of population to a community. We must therefore base our judgment of need upon rough common sense estimates and upon what is common elsewhere under like conditions. If this is a crude technique, it is at least trusted in business, industry, and politics; and it must serve here until a finer procedure is worked out.

A fourth bit of technique is the interpretation of the facts brought out by our tables. Here we are called upon to make an educational prescription with reference to a certain set of social or economic facts about a given community. What we do is to consider how much of a certain kind of educational activity is necessary to produce or modify in character or amount the particular social or economic phenomena for which our facts stand. This consists in the application of certain accepted educational principles and standards to a defined situation. To say here what principles and standards is obviously not possible except by way of illustration.

Let us say that our facts show in one part of a city a large industrial community where the people are mainly foreigners,

and where large numbers of young people of both sexes are employed in factories at as early an age as possible. How should we express the educational need which these facts reveal? What do these facts say about the subjects of civics and mathematics? Clearly the foreign child is less familiar with American social and political ideals and practices than are native children. Accordingly, the need for civics instruction in this community is relatively large. Add to this the fact that the children leave school early and go to work in factories. This means a further increase in need for civics teaching, and it also means that the mathematics should be connected up in a practical way with the points in industry with which the children are soon to associate themselves. Plainly, too, it argues for breadth in the information and experience to be brought into these, as into all courses, if we are to develop among these foreigners a culture that will best fit them into our American scheme of civilization.

Here we selected the principle that, *every child who is to become a citizen should be trained in the fundamentals of citizenship*, and the further principle that, *education must furnish a child with concrete contacts with the economic processes in which he will participate as an adult*, and roughly speaking yet another principle that, *educational need for a given kind of training exists in inverse proportion to the amount a child possesses by virtue of his social inheritance plus his experience and training to date*. Our technique of interpretation is the technique of educational diagnosis and prescription, and consists in selecting the principle or standard that applies and, by referring it to the facts in question, judging the amount or kind of education necessary to originate or modify those facts.

It is not necessary to say that this is not a routine matter, not a technique that can be learned in a few lessons. Nor should it be necessary to say that in applying these four bits of technique we are bound by the same logic that directs scientific study anywhere. Indeed, the facts we have proposed to assemble for the purpose of studying a community's educational needs might be assembled in a somewhat similar manner for other purposes. It is not a new logic, or a new set of principles of research that

the survey has built up, but rather a particular application of old logic and old principles to new ends. It is only in this sense that the technique here discussed is new.

Problem two: How to determine a community's capacity to meet its needs.—Here, as in the first of our four main survey problems, we shall present a practical outline for conducting the part of the survey having to do with the community's ability to meet its educational needs. Our first task, however, is to decide upon what basis we may say that a city is or is not able to support a given plan of education. Here again we must resort to the use of general social and educational principles. The first principle needed is: *A democratic state, being dependent upon the intelligence of its citizens, is obligated to provide some amount of education for every child.* A second principle is: *Possession of the simple tools of knowledge and some understanding of our social, economic, and political past and present, being essential to good citizenship, must be provided if the state is to have a proper margin of safety.* A third principle should be: *Beyond the minimum provision, and, up to full satisfaction of need, the amount of education provided should be determined by a community's financial ability.*

If we accept these principles and attempt to apply them, we must find a way to measure a community's financial capacity. In the following outline of this feature of a survey, we shall show the kinds of facts needed and where these facts may be obtained. We shall then explain how they should be treated. The decision as to what facts are necessary rests upon the simple truisms, (1) that a community's wealth or income determines the limit of its expenditures, and (2) that education is but one of several activities that must be paid for from the surplus of income over necessary expenditures. First, then, we need to know, how much wealth and earning power a city has, whether these are stable or fluctuating, and, if fluctuating, how and at what rate changes take place. Second, we need to know what the necessary expenditures are.

MATERIAL AND SOURCES FOR A SURVEY OF A COMMUNITY'S CAPACITY TO MEET ITS EDUCATIONAL NEEDS

I. Data needed:
   1. Population with rate of increase or decrease.
   2. Percent of dependents in population.
      a. School age and younger.
      b. Those retired from active life.
      c. Physical, mental, and moral dependents.
   3. Taxable and real wealth of community.
   4. Tax rate, total and for different purposes.
   5. Income or earning power of community.
   6. Dependability of sources of wealth.
   7. Amount and distribution of all public expenditures.
   8. Rate of increase in wealth and tax rate through a period of years.

II. Sources of information:
   1. Federal census reports of finance, population, and industries.
   2. Auditors' reports.
   3. Tax assessors' records.
   4. Local, state, and federal school reports.
   5. Income tax records.

It is impossible to present here full reasons for the inclusion of all these data. The above principles must serve as our general justification. Briefly, however, a study of real and taxable wealth will indicate the extent of the sources of income. The percent of dependents in the community will enable us to estimate the number of aggressive earners of wealth. A knowledge of the rate of change in population and wealth will permit us to anticipate possible income in the future. We need to know tax rate in order to see how heavily the community's income is now being drawn upon. We need to know the details of public expenditures because education is but one public interest calling for outlay. Finally, we need to know the tendencies in all these things, and we need to know them in comparison with similar communities elsewhere. All these we need to know for reasons that are reasonably obvious when their relationships are apprehended.

Our task, then, is to assemble the data to meet these ends, and to find some basis for interpreting the display when it is arranged. Tabular and graphic representations, temporal series of facts, and tables of comparative data are what we need in

order to show exactly what a community has in the way of purchasing power, and how it has been using its purchasing power. The technique of the selection and arrangement of data, and of determining a basis of measures, are no different from that discussed above. Here, as before, we measure a thing against itself, and against others of its kind. Experience is the basis of our judgment and the only basis we have so far devised. It is largely a matter of careful inspection and comparison.

Interpretation calls for judgment as to the importance of education as one of several public enterprises and as to when a community is spending up to its reasonable limit. It calls for judgment as to the stability of public income. In these processes we apply the comparative method, and such general principles as, that education should ordinarily call for a large expenditure in comparison (for example) with police protection, and that every source of wealth should be made to bear its share of the public burdens. But to go into the details of the reasoning necessary to full interpretation is impossible here.

Problem three: How to evaluate the present efficiency of the schools.—So far it appears that the survey method is a sort of rough and ready reasoning. Thus far we see an array of facts, and analysis of the facts, and the application of axioms and principles but no exact measures of anything. This only serves to point out the difficulty of survey work. It does not argue that there is no special survey technique.

In handling our third function in a survey, that having to do with the evaluation of the present efficiency of a school system, we shall introduce, in addition to the methods thus far described, a more exact procedure. Here we are concerned with a measure of things as they are. How much education have we; how well organized and managed is it; what is the value of the training given; how effective is the training; how adequate the housing and equipment, the staff, the supervision, and the curriculum? These are the types of information we now seek. To show the nature of the procedure, let us first examine an outline of the information needed, together with the sources from which such information can be secured.

MATERIAL AND SOURCES FOR A SURVEY OF THE PRESENT EFFICIENCY OF A SCHOOL SYSTEM

I. Data needed:
   1. The larger problems of administration.
      a. The present school policy.
      b. The legal and administrative organization.
      c. Finance and business management.
      d. Buildings and the building program.
      e. The teaching and supervisory staff.
      f. The system of records and reports.
   2. The internal administration and management.
      a. Child accounting.
      b. The course of study.
      c. Grading and promotion.
      d. The daily program.
      e. Vocational and educational guidance.
      f. The system of grades and marks.
      g. Equipment and supplies.
   3. Efficiency of instruction and supervision.
      a. Instruction measured.
      b. The supervision of instruction.
      c. Health supervision.
      d. The place and function of research, investigation, and experiment in a public school system.

II. Sources of materials:
   1. Practically all the sources mentioned above.
   2. All school records, reports, laws, and regulations.
   3. The schools and community as they can be studied by inspection and measurement.

It is by no means possible to discuss here all the methods of investigation suggested by this outline, nor even to enumerate all the different kinds that may be needed. Such methods as have been discussed above apply at many points. In addition we have a special technique for studying the rate of progress children are making in their work, another for measuring the efficiency of buildings, another for instruction, another for grading and promotion, another for the daily program, another for class marks, another for the staff, another for finance, and so on. Moreover, the findings of one of these studies may be brought to bear upon another (for instance, the results of the study of retardation as a basis for judging the administration of the curriculum).

In the development of these various methods we have not only had to analyze the problems so that we could locate and define causal relationships, but we have had to figure out ingenious devices for finding the particular truth we need in a given case; and finally we have sought some norm or standard against which to measure the product brought to light by the application of our device. Everywhere we have had to decide what information is needed, what combinations of facts will give this information, and how these combinations can be made. Axioms, principles, devices, or standards must be selected accordingly as the one or the other applies. The most technical task is not to obtain a knowledge of these tools, but to know when, where, and how to use them to get at the truth.

By way of illustration suppose that the efficiency of instruction is to be measured. Obviously our first need is an instrument of measurement. Let us use a standard test or scale. The selection of a test or scale then becomes a question. Clearly we want the one that will most accurately measure the thing in question. But what is this thing? Here, among other things, we must choose between measuring what the schools have taught (or intended to teach) and what we think ought to have been taught. Our aim in measuring will have a direct bearing upon our interpretation of results. After we have our instrument and have decided what to measure, we must then carry out the various processes of measuring. We must apply the test, assemble and interpret the scores and define the results. Each of these steps calls for some bit of technical knowledge or skill. When we consider the wide diversity of processes, products, and materials a measure of which our outline calls for, we see the need, not for a brief paper, but for a large volume on the technique of surveying. This one brief illustration can at best suggest only vaguely the many special knowledges and skills which a surveyor must have at his command for this part of a survey.

Problem four: How to outline a constructive program for the future.—Finally, in a survey, we come to the end of investigation. We have before us the facts as to what the community needs, as to what it can afford, and as to what it is getting in

the way of school efficiency. The next step is to say what all this means in terms of a future program. Here we must make clear where the aims, the machinery, and the processes of the schools are weak or short of what the community is able to have, and then show what needs to be done to bring the schools up to their best possibilities.

When we show that a piece of organization, a process or an aim is weak or wrong, we must use a suitable terminology. Similarly, when we point the way toward the amount or kind of aim, organization, or process which the community should have, we must have a basis or standard with reference to which this advice is given. These standards are quantitative if we refer to success in studies or to amount of progress in grades; but if we refer to aims and purposes—and often when we refer to processes and products—we must utilize axioms, general principles, and experience elsewhere as our bases or standards.

For instance, if we wish to advise the schools to spend more money on supervision, we must show by test results, by comparison of the amount of supervision provided with the amount provided elsewhere, and by an analysis of the supervisory organization that poorer results are obtained than elsewhere, and that wrong principles of organization are in use. We must also show what results can be secured, what principles of organization should operate, and what amount of money should be spent. Expenditures in the community in question must be compared with those for the same purposes in comparable communities elsewhere. Results likewise must be compared. The conviction may finally be created, through a process of deductive reasoning, that the things recommended—things proved to be both desirable and possible—ought to be put into effect in the school system in question.

Conclusions.—It has been the purpose of this paper to bring to light something of the school survey technique. Incident to the treatment it has been necessary to discuss the nature and purpose of a survey and to offer in outline a survey plan.

As presented the technique includes a choosing of aims and facts and the formulation of plans of study. It calls for the

selection and application of axioms, principles, devices, standards, and comparisons in the examination of the aims, facts, relationships, and conclusions dealt with. In the main, the technique is new and specific only in the sense that old principles, old logic, old standards are applied to new ends, under new conditions, and in new combinations and relationships. In range the survey technique includes the simplest processes of counting and the most exacting processes of reasoning. It includes the application of simple facts or truisms as well as the most complicated statistical devices.

The mastery of such a technique can come only with years of study. We have made great progress so far, but the work yet to be done is enormous. We must have more definite measures, more clearly defined principles, more short method devices. These will come partly as a result of laboratory work and partly from hard experience gained by survey work. The field is rich with possibilities of great practical service and great scientific achievement. In a sense the survey has provided the greatest stimulus that the scientific study of education has yet received because it has furnished the highest goal of scientific study, namely, the opportunity to render needed service.

MINIMUM ESSENTIALS IN PLACE GEOGRAPHY

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The Importance of a Minimum List

Modern methods of teaching geography emphasize human relationships and the application of geographic principles to everyday life. One of the essential outcomes, however, should be a knowledge of important places. Indeed, such a knowledge is necessary for the appreciation of the activities of people and in making proper adjustments to environment.

The large number of places mentioned in the daily newspapers illustrates the need for knowledge of place geography. In an examination of the first page of the *Columbus Despatch*, October 1, 1922, the author found a surprisingly large number of places indicated. Table I shows these places and the number of times they occur.

A similar study of the first ten pages of the *Literary Digest*, September 30, 1922, which contains a weekly digest of important newspapers, showed the names of the following places occurring five or more times: Smyrna, Constantinople, New York, Wash-

TABLE I. FREQUENCY OF MENTION OF GEOGRAPHICAL PLACES ON A NEWSPAPER PAGE

Place	Number of Times Mentioned	Place	Number of Times Mentioned
Constantinople	11	Erin Keni	1
Ohio	8	Rome	1
Washington, D. C.	5	Great Britain	1
Paris	5	Dardanelles	1
Cleveland	4	Amsterdam	1
Toledo	4	Doorn	1
Athens (Greece)	3	France	1
United States	3	Massachusetts	1
London	3	Columbus	1
Chanak	2	Italy	1
Smyrna	2	Mudania	1
San Francisco	2	Kara Bournow	1
New York City	2	Chicago	1
Panama Canal	1	California	1
Dayton	1	North America	1

ington, Philadelphia, Europe, Turkey, France, Great Britain, and the United States. Forty-four other names of places occurred one or more times.

Pupils cannot be expected to remember all the places mentioned or discussed in class. Nor can any course of study anticipate the large number of places which current papers or magazines may mention from time to time. As a matter of fact, it is doubtful if the majority of pupils in American schools even know where the world's most important places are located. In June, 1920, Dr. B. R. Buckingham and the author made an investigation of the ability of pupils to locate important places both in the United States and in other parts of the world. A large number of place-geography items were arranged in the form of tests and submitted to pupils. The items on United States place geography were given to 6,339 grammar-grade pupils in the following states: Illinois, New York, Florida, Oregon, Arizona, Connecticut, and Montana. The items on world place geography were given to 7,849 grammar-grade pupils in the following states: Illinois, Maine, Connecticut, Colorado, and Kansas.

The results of this investigation showed conclusively that the average elementary pupil's knowledge of place geography is very limited. Table II is a summary of the results obtained on a few of the items. For example, it will be noted that only 65 percent of the pupils knew that Egypt is in Africa; 66 percent, that Persia is in Asia; 44 percent, that the Himalaya Mountains are in Asia; and so on. The pupils' knowledge of their own country seems to be no better as indicated by the last questions in the table.

The examination of such data leads one to ask the question, "Why do pupils know so little concerning the location of places in their own country, and the world as a whole?" In the author's opinion, this may be explained by the fact that among the large number of places which are presented to the child in his study and recitations, no definite distinction is made between the places of major and minor importance. The pupil, in attempting to cover too much ground, fails to fix either the important or unimportant places in his mind. If this explanation is correct, he

TABLE II. ACCURACY OF RESPONSE ON SELECTED ITEMS

Questions	Percent of pupils in grades V-VIII who answered the questions correctly.
Egypt is on what continent?	65
Persia is on what continent?	66
The Himalaya Mountains are on what continent?	44
The Andes Mountains are on what continent?	59
The Baltic Sea is nearest to what continent?	69
The Nile River is on what continent?	62
Into what ocean does the St. Lawrence River flow?	80
Into what ocean does the Amazon River flow?	70
Armenia is on what continent?	27
In what state is San Francisco located?	80
In what state is New Orleans located?	55
In what state is Cincinnati located?	40
In what state is Louisville located?	27
In what state is Omaha located?	23
In what state is the Garden of the Gods located?	15
In what state is Mt. Shasta located?	17
What state is next north of Kansas?	38
What state is next west of Connecticut?	25
What state is next east of Oregon?	69
What state is next south of Kentucky?	38

should have some drill on the location of a minimum number of important places. Miss Day has mentioned this fact in her excellent article on the Teaching of Place Geography.[1] She says:

"The first problem that confronts the teacher is to decide what places shall be taught. Place geography being only a phase of the larger field of the subject, it is necessary to guard against the teaching of too many places. A list of places to be used as a basis for the work may be provided by the teacher, or by using lists found in school journals, various courses of study, maps, and other geographical publications."

The Selection of a Minimum List

The average grade teacher does not have the proper background for selecting the most important places. A carefully selected list of prominent countries has been made by Branom.[2]

[1] Day, Rachel E., "The teaching of place geography." *The Journal of Geography*, 21: pp. 109-115. March, 1922.

[2] Branom, M. E. and F. K. *The teaching of geography*. Ginn and Co., 1921, pp. 276-277.

In determining this minimum list of countries Branom used the following criteria: (1) the area of the country in square miles; (2) population; (3) total value of imports; (4) total value of the imports from the United States; (5) total value of exports to the United States; and (6) total value of exports. Concerning these criteria Branom[3] says: "These criteria not only offer objective data of great significance in the study of a particular country but also afford a means of measuring the relationships of the United States to each country." A list of fifty-two countries was thus set up and ranked in order of importance. The United States, Great Britain, and Germany headed the list, while those of lowest rank were Salvador, Paraguay, and Siberia.

To obtain a list of other important place-geography items, the Bureau of Educational Research at Ohio State University submitted a large list of places, rivers, and other factors to fifty-five geography experts. These people—heads of geography departments in normal schools and universities, and supervisors of geography in city school systems—were asked to cross out any item which they did not consider of sufficient importance for the pupils to learn and remember. As a result of the judgments of these fifty-five people, five lists were made up. The first list consisted of items which, in the opinion of all the judges, elementary-school pupils should learn and remember; the second of those upon which 90 to 99 percent of the judges agreed; the third list of those upon which 80 to 89 percent agreed; the fourth list of those upon which 70 to 79 percent agreed; and the fifth list of those upon which less than 70 percent agreed. The following lists are examples of the items found in the different groups.

Testing Minimum Essentials

A complete list of the places which 90 percent or more of the judges considered important were embodied in tests.[4] The United States Place Geography Test is composed of three forms

[3] *Op. cit.* pp. 273.

[4] Place Geography Tests. The World and the United States. Forms I, II, and III, by B. R. Buckingham and P. R. Stevenson, Bureau of Educational Research, Ohio State University. Published by the Public School Publishing Company, Bloomington, Illinois. 1922.

TABLE III. THE PERCENT OF JUDGES CONSIDERING CERTAIN SELECTED PLACE-GEOGRAPHY ITEMS IMPORTANT

List 1 (100 percent)	List 2 (90–99 percent)	List 3 (80–89 percent)	List 4 (70–79 percent)	List 5 (Less than 70 percent)
Gulf of Mexico	Persian Gulf	Baffin Bay	Mohave Desert	Cape Cambodia
Cape Horn	Cape Cod	Parana River	Amur River	Blanco Bay
Ganges River	Yukon River	Lake Baikal	Cyprus	Lake Peipus
Lake Superior	Lake Winnipeg	Tasmania	Salvador	Dvina River
China	Irish Sea	Albania	Foochow	Gulf of Oman
Alaska	Formosa	Mt. Hood	Keif	Mt. Logan
Mt. Everest	Niger River	White Sea	Perth	Lake Ladoga
Berlin	Bombay	Aral Sea	Lake Chad	Mt. Kenya
Rome	Amsterdam	Honduras	Cape Verde	Soochow
Seattle	Pyrenees Mts.	Tunis	Murray River	Fusan

with 60 exercises each, and the World Place Geography Test of three forms of 70 exercises each. One of the distinguishing features of these tests is that the pupils do not need individual printed blanks. One printed booklet for each teacher or school is all that is needed. The pupils write their answers on any ruled paper which happens to be used in the school. The cost of giving the test is reduced to practically nothing since all the forms of both the United States and the World Tests are printed in one twelve-page booklet and may be used over and over again.

A summary of the advantages of this type of test is as follows: (1) the places to be located are those which, in the judgment of experts, the average person ought to be acquainted with; (2) they are short and may be quickly given and scored; (3) they require a minimum amount of expressional effort on the part of the pupil, only one word or abbreviation being required in each exercise; (4) there are no debatable answers; (5) they are convenient for quick review to see where the pupils need help in place geography—whether cities, rivers, countries, etc.; (6) a large amount of testing may be done at a very small cost.

The author, of course, is aware of the fact that place geography is only one of the factors to be considered in measuring the results of geography teaching. The Bureau of Educational Research at Ohio State University has been making an intensive study of geography and has sought the advice of a large number of geography experts. The place-geography tests are therefore only a part of a proposed series of diagnostic tests.

Another part is a problem test which attempts to measure the ability of the pupil to apply geographical principles to concrete situations. Still another part is an information test[5] which is intended to measure the pupil's knowledge of important human relationships. A study is also being made to determine the technical vocabulary necessary for reading geography texts, geographical readers, and current news articles. When this study has been completed the important words will be embodied in a vocabulary test.

Practice Exercises on Minimum Essentials

Testing procedure has no real place in the public schools unless it helps in the improvement of instruction. Many enthusiastic workers have given tests and have found out where their pupils stand in relation to other pupils; but they have made no consistent effort to remedy matters. The author is preparing practice exercises in place geography to help the teacher emphasize the items upon which the pupils have failed.

These exercises are based upon outline maps of the United States and the World. The names of states, continents, bodies of water, etc., are not given, but upon the respective items numbers are placed. For example, the states in the United States map are numbered from 1 to 48 inclusive. Each pupil is given an outline map. With this map in hand the pupil may answer the teacher's questions either orally or in writing. The answer may be the number of the state as indicated on the map, the abbreviation of the state, or the name of the state. In rapid written exercises the number of the state has been found to be a great economy of time. Twenty-five to fifty questions may be answered by the pupils in five minutes. The papers may also be corrected in a very short time. The pupil corrects his own or his neighbor's paper as the teacher reads the correct answers. Some of the suggested practice questions on place and informational geography are as follows: (The answer may be the num-

[5] A problem-information test on the United States will soon be ready for distribution. It will be published by the Public School Publishing Company, Bloomington, Illinois. Douglas C. Ridgley of Clarke University is cooperating with the authors in developing this series of tests.

ber, the abbreviation, or the name of the state according to directions given to the pupils.)

1. What is the number of New York?
2. In what state is Chicago?
3. What state is south of Kansas?
4. Through what states would you pass in going directly from Kansas City to Denver?
5. Which state has the higher elevation, 1 or 20?
6. Which state mines the more coal, 25 or 13?
7. Which state has the larger percent of colored population, 16 or 48?
8. Which state has the warmer winters, 21 or 36?
9. In what state is Pikes Peak located?
10. In what state is the Great Salt Lake?

Other questions may be asked on relative distances or general directions such as:

1. What general direction is Alabama from Illinois?
2. About how far is Chicago from New York City? (In answering such questions a ruler may be used in connection with the scale given on the map.)
3. Which state is farther north, Oregon or New Jersey?
4. In what general direction does the Mississippi River flow?
5. In what part of the United States are the Rocky Mountains located?

Investigators who have studied methods of teaching spelling suggest that pupils be asked to write the words in a given lesson before studying them. Then, the words which a pupil already knows do not need to be studied. His time may be spent on the words which are new or difficult for him. The same time-saving method might very well be applied to place geography. The teacher, upon receiving pupils from a lower grade, should test their knowledge not only on the work already covered in the previous grade but also on the places to be studied under her instruction. Emphasis may then be placed upon the items with which the individual pupils are unfamiliar. Intelligently directed drill exercises of from five to ten minutes once or twice a week will doubtless be sufficient to fix these items in the pupils' minds.

In advocating the use of these practice exercises, the author does not consider it necessary that more time be spent on place geography, but he does suggest that the time now spent be used to better advantage.

THE INTELLIGENCE QUOTIENTS OF ADULTS AND RELATED PROBLEMS

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With the exception of the results from the testing of intelligence in the United States Army, representative data have not been available from which it has been possible to estimate the average intelligence of age groups after the chronological ages of 13 or 14. From the ages of 7 or 8 up to 13 or 14 the age groups in schools are sufficiently representative. After these ages the groups are selected as a result of the elimination of pupils from school. In consequence of this fact mental ages over 14, as assigned in the Binet tests and in the various group intelligence tests are somewhat hypothetical. If, however, the age at which large numbers of children begin to leave school is really the age at which mental growth ceases *on the average*, as is suggested by the results of the Army testing, the solution of various problems of adult intelligence would be much simplified. This coincidence, if it be such, may, however, simply indicate that the tests in question measure chiefly the habits and interests ordinarily acquired in school, which many adults may either have never learned well or have forgotten. In their place other interests and habits may have been acquired, in other environments than the school, which are quite as significant for any adequate estimate of intelligence, but which the tests in question do not adequately test. That children of 12 and 13 in school do as well[1] on the average as the adults in the Army did in these tests may, for example, be due in part to the skill which children have acquired from recent practice in the use of paper and pencil, in the carrying out of directions, in writing, figuring, etc.,—a skill which many of the adults may have lost. On the other hand, the

[1]See results of Proctor with the Army Alpha Examination in *Psychological tests and guidance of high school pupils.* (Journal of Educational Research Monograph No. 1); and DeVoss, *Manual of instructions for use with the Army Alpha Intelligence Examination in public schools*, p. 20.

considerations presented by E. A. Lincoln in a recent article on "The Average Adult Mental Age"[2] seem to the writer sufficiently conclusive to place the average adult mental age, in so far as it can be determined by these tests, nearer to 13½ than to 16 as assumed by Terman in the Stanford Revision of the Binet Tests.

The same limitations apply in good part also to the Binet tests. The latter are excellent measures of actual and potential grade progress. That they measure as successfully abilities expressed in other forms of learning is, however, doubtful. The limitations may apply somewhat less to the series of tests used in this study, because of the smaller proportion of the tests, for the ages in question, depending on scholastic training. Half of the tests and half the credits are for performances which may have been learned as well out of school as in school. Furthermore, the individuals included in the first part of this investigation were still in either the regular or continuation schools and may, therefore, have been in a somewhat more favorable position than were the adults in the Army tests. The determination of the proportion of those whose development has been inhibited by their school training, prolonged retardation in grades, etc., and for whom out of school learning would have been a fairer gauge of their intelligence awaits the development of more adequate tests than are now available.[3] It is generally recognized that mental tests do not measure the mental ability of an individual directly but gauge his ability by what he has learned or by the use to which he can put his learning in novel situations, and in either case a modicum of "drive" or of interest in the learning is assumed. His habits or acquisitions cannot, however, be appraised without taking into account the incentives and opportunities which he has had for their acquirement. In other words, environment cannot be left out of the reckoning; it is part of the equation.

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[2]Lincoln, E. A. "The average adult mental age," *Journal of Educational Research*, 6:133-44, September, 1922.

[3]See in this connection a statement by the writer in regard to the measurement of intelligence in the *Journal of Educational Psychology*, April, 1921, p. 210.

The majority of tests in current use are reliable aids in the differentiation of the sort of abilities which the school fosters and prizes. On the basis of these results, alone, however, we should be chary of pronouncing judgments on the intelligence of those whose learning may have taken a quite different course.

The findings in regard to general physical and physiological development and such considerations as are presented by various writers[4] for placing the average age of full maturity at a higher age must be kept in mind. The writer, however, does not propose in this article to enter further into these discussions, but proposes, first, to present new findings in regard to unselected groups of fourteen- and fifteen-year-olds, and, secondly, to test the assumption of a lower mental age for the average adult by applying it to data secured from the testing of practically all of the children of three communities from the ages of 8 to 13 inclusive, and those who remained in school after these ages. A method will also be presented for calculating, on the basis of the assumed average, the intelligence quotients of individuals who score above this average. The values secured are directly comparable with those secured, in the case of scores below this average, by the usual method of dividing the mental by the chronological age. The method obviates the necessity for other indices or coefficients of brightness than the usual intelligence quotients.

One misconception, common at least to the lay mind, in speaking of the average mental age of adults may first be mentioned. If this age is assumed to be 14½, as will be assumed for the purposes of this article, it must be noticed, of course, that this is an average and that all of our findings would lead us to expect as great a range of variability on the one side of this average

[4] Otis, A. S. "A criticism of the Yerkes-Bridges point scale with alternative suggestions," *Journal of Educational Psychology*, 8:129-50, March, 1917; and "Absolute point scale for the group measurements of intelligence," *Journal of Educational Psychology*, 9:239-61, 333-48, May-June, 1918; Buckingham, B. R. and Monroe, W. S. *Illinois Examination. Teacher's handbook.* Bloomington, Illinois: Public School Publishing Company, 1920, p. 4; Brooks, F. D. *Changes in mental traits with age.* (Teachers' College, Columbia University Contributions to Education No. 116); Kuhlmann, F. "The results of repeated mental re-examinations of 639 feebleminded over a period of ten years," *Journal of Applied Psychology*, 5:195-224, September, 1921.

as on the other. Individuals of adult years are commonly known who, without the direct incidence of accident or disease, can only pass the mental tests of two-year-olds, one-year-olds, or less. At the other extreme we should expect to find individuals as much superior to the average as the one-year-olds are inferior to it. The final status of the individual variant and of the average is dependent on at least three factors, the initial status or native ability, the rate of growth, and the duration of growth. ("Environment" should also be added.) There is evidence of some positive correlation between these factors, that is, for example, that the development of initially superior minds is more rapid and distributed over a longer time. The recently published results of Kuhlmann[5] support this conclusion, although they indicate that the differences in the *duration* of the period of development are not as great as hitherto assumed.

A more serious difficulty, in the application of the above assumption to our data, arises from the finding, which is common to the results of group testing, that the average increments in mental growth appear to be uniform up to this age; and it is

TABLE I. AGE STANDARDS, DEARBORN GROUP TESTS OF INTELLIGENCE, SERIES II

Age	8½	9½	10½	11½	12½	13½	14½
Scores	25	37	49	61	73	85	97
Number of Cases	400	429	395	413	379	412	337

difficult to maintain that it ceases abruptly. The standard scores for the ages 8 to 14 in Table I are almost the exact medians (with slight smoothing) of the age groups in question.[6]

The average number of cases for ages 8 to 13 inclusive is 404, the number of fourteen-year-olds is 337. The decrease in the

[5] Kuhlmann, F., *op. cit.*

[6] The scores are those which have been adopted as standards for the revised edition of Series II of the Dearborn Group Tests of Intelligence. The method of standardizing rested on other considerations than the exact medians and is described in the *Journal of Educational Psychology*, May, 1922. The median scores for the age groups in question are as follows: *8*, 25; *9*, 35; *10*, 48; *11*, 64; *12*, 72; *13*, 85; *14*, 99.

number of cases at 14 years is due chiefly to the elimination of children as they reach the age of 14, so that the fourteen-year-olds become a selected group. Since, as will be shown below, this elimination includes a greater proportion of those below than of those above the average in intelligence, those remaining are a superior group. The increment in score is due, therefore, in part to selection and in part to growth. In view of this fact it may be argued that the average rate of growth is decreasing at this period.

There are also other considerations to be taken into account. The average in question is a combined average for boys and girls. It is evident from some preliminary analysis that there are considerable sex differences at this period.[7] The average of the two curves may be considerably different from that of either alone. Moreover, it is possible that there are abrupt changes at this period in the individual growth curves. This can be proved only by repeated tests of the same individuals. An increase observed in the variability of the age groups at ages 12, 13, and 14 is presumably due to this factor and to the sex differences. The changes in variability are shown in Table II in terms of the semi-interquartile ranges of the scores, mental ages, and intelligence quotients.[8]

Finally, the form of the curves may be varied at will depending on the nature and difficulty of the tests given at various ages,

[7] See chapter on sex differences in L. Thomas Hopkins' *The intelligence of continuation school pupils in Massachusetts* to be published in the Harvard Studies in Education. A more extended investigation of sex differences in these tests is now being made by Mr. E. A. Lincoln.

[8] It should be noted in passing that the commonly accepted averages for other forms of growth, e. g., physical and physiological development, are probably in need of some correction after age 13, since they have also been based only on children who remain in school. How much of the increment in height after age 13 is, for example, due to the factor of selection? Presumably not much, but this possibility must be considered by those who argue in regard to mental growth on the analogy of the usually accepted averages in regard to physical growth. See, for example, the effects of selection in the differences between the "Längenwachstum von Berliner Gymnasiasten und Gemeindschülern," W. Camerer in *Handbuch der Kinderheilkunde*, p. 244. Also Baldwin, B. T., *Physical growth of children from birth to maturity*, (University of Iowa Studies, Vol. I, No. 1) Table III, p. 32. Fourteen-year-old children granted working certificates were at least equal to the norms, the fifteen-year-olds are under the norms in height and weight.

TABLE II. VARIABILITY OF SCORES, INTELLIGENCE QUOTIENTS, AND MENTAL AGES

Age.....	8	9	10	11	12	13	14	15	16
Score.....	10.2	11.5	14.8	15.2	20.3	22	20.1	17.7	15.
I. Q.'s.....	10.1	10.	11.7	11.4	13.	13.7	11.6	9.8	9.2
M.A.(months)	11.0	11.5	14.5	14.5	20.5	22.	20.	17.5	15.5

and the points of score considered as units. This would also be true of the Binet but for the fixed method of counting units. A year of mental growth in the Binet tests is counted as one unit, although the amounts of such growth in one year may vary at different periods. The only information required in the following discussion is at what age period there is on the average no advance over other age periods. This last consideration may be illustrated by the graphic comparison (Figure 1) of the *scores*

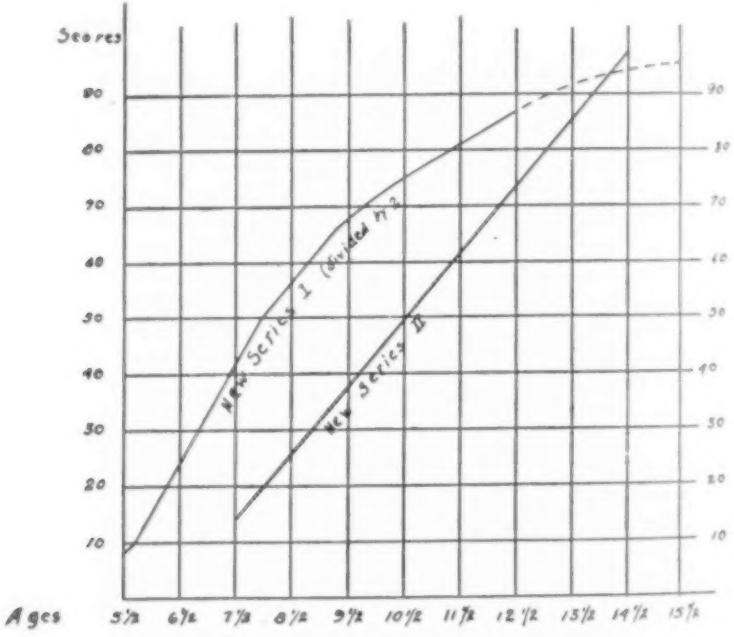

FIGURE 1. AGE STANDARDS, DEARBORN GROUP TESTS OF INTELLIGENCE, NEW SERIES I AND II

in Series I and II of the writer's group tests. Reliable averages for the First Series have been obtained only up to the age of 12; the dotted line indicates the probable course of the curve after this age. The scores of this Series have been divided by two in order to make the comparison easier with the scores of Series II.

To turn now to the findings on the first mentioned data. The standard scores and mental ages in both individual and group tests in current use are based almost exclusively on the results obtained from children in the regular grades and high schools. The Massachusetts laws require that children who leave the regular schools between the ages of 14 and 16 years must attend continuation schools. If we are to secure an unselected group on which to base our average, these children must be included with those in the regular schools. An investigation now being made at the Harvard Graduate School of Education by Mr. L. T. Hopkins[9] has supplied this necessary information in regard to practically all of the fourteen- and fifteen-year-olds in several Massachusetts cities. In one typical city, there are found to be 454 fourteen-year-olds and 457 fifteen-year-olds. The mean scores of the fifteen-year-olds in the Dearborn Group Tests[10] show no appreciable advance over the fourteen-year-olds. The scores and mental age equivalents are shown in the last two columns of Table III.

If one considers those in the regular schools alone as has hitherto been done, the fifteen-year-olds advance over the four-

TABLE III. MEAN SCORES AND MENTAL AGES OF PUPILS FOURTEEN AND FIFTEEN YEARS OLD

	In Regular School		In Continuation School		In All Schools	
	(1) Age 14	(2) Age 15	(3) Age 14	(4) Age 15	(5) Age 14	(6) Age 15
Scores	119	129	81	89	110	111
Mental Ages	14–5	15–1	11–10	12–4	13–9	13–10
Number of Pupils	342	249	112	208	454	457

[9] *The intelligence of continuation school pupils in Massachusetts.*

[10] The scores are of Series II, General Examinations 4 and 5. Scores and comparisons made elsewhere in this article are, except as noted, based on the Revised Series II, General Examinations C and D.

teen-year-olds (columns 2 and 1 of Table III). This is the resultant, as pointed out, of the elimination of the continuation-school group. There are 112 of the fourteen-year-olds and 208 of the fifteen-year-olds in the continuation school. Their average scores are respectively 38 and 40 points less than those in the regular schools. In terms of mental age they average, respectively, 2 years and 7 months, and 2 years and 9 months lower than the pupils in the regular schools.

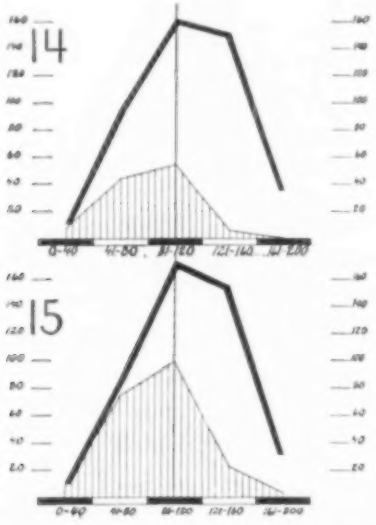

FIGURE 2. SCORE DISTRIBUTIONS BY AGE IN THREE MASSACHUSETTS TOWNS. SERIES II, GENERAL EXAMINATION 4 AND 5

In Figure 2 the distributions of the scores of all the fourteen-year-olds and of all the fifteen-year-olds are shown by the heavy lines. The shaded areas show the scores of the continuation-school groups. The similarity in the form of the two distributions is striking. The only children of these ages in the cities who are not included are those in the private and parochial schools. The records returned by these schools show that there are 126 of these children. The fourteen- and fifteen-year-olds are not separated in these returns; but they must be approxi-

mately equal, judging from equality in the numbers of these ages in the public schools. Possibly these children might somewhat raise or lower the average scores of both groups; but probably they would not affect the similarity of the groups nor the equality of their averages because, aside from the small number of cases involved, it is not likely that the sort of fourteen-year-old children going to private and parochial schools differs materially from the sort of fifteen-year-olds going to these schools.

The average mental ages of these two total groups in terms of the standards of the Dearborn Group Test are 13 years 9 months and 13 years 10 months respectively. The average mental ages of some 3400 fourteen- and fifteen-year-olds in the cities so far studied are practically the same; namely, between 13 years 8 months and 13 years 10 months. If these cities were typical of the country at large, we should need to assume that the average adult age, as far as these tests show it, is between thirteen and a half and fourteen. For various reasons, chiefly because of the proportion of children of foreign born parents, we do not believe these communities, or at least the results of the tests, are quite typical of the average population of the country—hard as that is to estimate. The discussion in connection with Table I also pointed to an average age nearer fourteen, but for the purposes of the present argument, we shall, as noted above, assume the average adult age to be somewhat higher; namely, fourteen and a half.

If we make this assumption and change our scores (by a method described in the appendix to this article) into intelligence quotients, we have two ways of calculating the quotients. We may calculate them in the usual way, by dividing the mental age equivalents of the scores by the chronological ages of the pupils, or the fourteen- and fifteen-year-old scores or score equivalents may be divided by no chronological age higher than fourteen and a half.

The results in the case of the fourteen-year-olds are (omitting decimal points) practically the same by either method. But if we use the usual method for the fifteen-year-olds, those in the

regular schools have a slightly *lower* median I.Q. (101 instead of 102) than the fourteen-year-olds, although we know that, because of the removal of pupils to the continuation school, they must average higher than the fourteen-year-olds. The total group of fifteen-year-olds average but 90 I.Q. as compared with 96 for the fourteen-year-olds, whereas they should average the same. Calculating the I.Q.'s on the basis of 14½ as the average adult age, the findings are such as the facts established by the scores would indicate; namely, first a gain in the average I.Q.'s of the fifteen-year-olds in the regular schools of five points, and secondly, about the same average I.Q.'s, 96 and 95, for the total groups of fourteen- and fifteen-year-olds. The different results by the two methods are shown in Table IV and in Figure 3. The broken lines in the figure show the results by the usual method, the continuous lines by the proposed method. The I.Q.'s are plotted in intervals of 15 points.

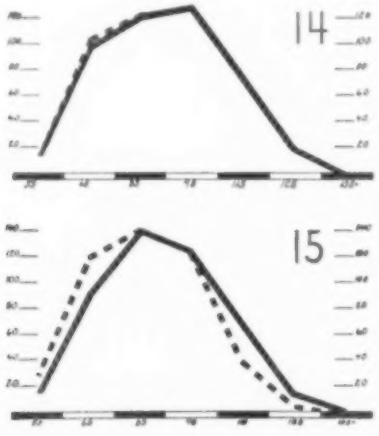

FIGURE 3. I.Q. DISTRIBUTIONS FOR FOURTEEN- AND FIFTEEN-YEAR-OLD PUPILS IN ONE MASSACHUSETTS TOWN. SERIES II, GENERAL EXAMINATION 4 AND 5. SOLID LINES ARE THE RESULT OF TAKING THE ADULT AGE AS 14 YEARS AND 6 MONTHS. THE BROKEN LINES ARE THE RESULT OF TAKING THE ADULT AGE AS 16 YEARS

TABLE IV. MEDIAN INTELLIGENCE QUOTIENTS OF FOURTEEN- AND FIFTEEN-YEAR-OLD PUPILS

	In Regular Schools		In Continuation Schools		In All Schools	
	Median	Quartile Deviation	Median	Quartile Deviation	Median	Quartile Deviation
Fourteen	102	12	83	6	96	13
Fifteen						
(a) Average Adult Age = 16	101	10	80	7	90	12
(b) Average Adult Age = 14½	106	10	85	8	95	13

(Median Score = 85. ; −Q = 22. ; +Q = 22.
Median I.Q. = 100.5; −Q = 13.8; +Q = 13.8)

The method will now be applied to the age and grade distributions of three communities in which the tests were given from the second grade through the high school. A study of the effect in these communities of changes in population and of school elimination and retardation warrant the conclusions that the pupils who remain in school after the age of 14, and after the seventh grade, are considerably superior to the preceding age and grade groups. The calculation of the I.Q.'s of these groups on a basis of 14½ as the average adult age, gives results in closer agreement with this generally accepted conclusion, than by calculating on the basis of sixteen years or over.

The chief findings in regard to the influence of elimination and retardation for the single year investigated are as follows:

1. The median intelligence quotients of those who left school in the three towns was 100 for ages 10 to 13 inclusive (81 cases), whereas it was 90 for ages 14 to 16 inclusive (109 cases).

2. The median intelligence quotient of those given work certificates in two of the towns at the age of 14 and over was 89 (21 cases). The facts for the third town were not available.

3. The median intelligence quotient of those not going on to high school in this third town was 84 (17 cases).

4. The median intelligence quotient of those failing of promotion in one town in the year since the tests were given was 87. The median has not been established for the other towns, but it is believed to be considerably lower.

It has not been possible to study thoroughly the effect of possible changes in the population, but such inquiries and observations as could be made seem to support the conclusion that, taking the three towns together, there has not been any marked change in the character of the population and that, therefore, the differences between the average intelligence of pupils in grades II to VII, and VIII to XII, and before and after age 14, are due to the selective influences of elimination and retardation.

These differences are shown in the following Table V:

TABLE V. MEDIAN I.Q.'S AND VARIABILITIES BY AGE AND GRADE IN THREE MASSACHUSETTS TOWNS

Grade	Number of Cases	Basis of Calculation				Age	Number of Cases	Basis of Calculation			
		Usual		Proposed				Usual		Proposed	
		Median	Q	Median	Q			Median	Q	Median	Q
II	380	97.9	8			7	235	101.7	7		
III	401	96.4	10			8	388	101.4	10		
IV	409	97.6	11			9	417	99.0	10		
V	407	100.8	10			10	377	100.5	12		
VI	387	101.3	11	101.3	11	11	387	102.9	11		
VII	416	99.3	13	99.4	13	12	385	100.2	13		
VIII	325	104.2	12	104.8	11	13	397	100.5	14		
						14	332	101.5	11	101.8	12
IX	286	106.5	10	108.1	9	15	257	101.6	9	107.6	10
X	265	105.6	8	110.7	7	16	223	102.0	8	111.7	9
XI	203	107.0	7	114.5	8	17	101	105.1	8	115.0	8
XII	131	108.1	7	119.7	8	18	37	103.8		114.3	

The average I.Q.'s of age groups up to 13 inclusive and of grades V to VII inclusive are approximately 100. The lower medians in grades II, III, and IV are due to the retarded pupils. On the usual basis of calculation, the I.Q.'s of the fifteen-year-olds average the same as the fourteen-year-olds, namely about 101. On the proposed basis the I.Q.'s of the fifteen-year-olds average 107, the sixteen-year-olds nearly 112, and the seventeen-year-olds 115. The median I.Q.'s of the high-school pupils advance, by the usual method of calculation, but little over the I.Q. of the eighth grade; 104 for the eighth grade and 108 for high-school seniors. By the proposed method the high-school seniors average about 15 points higher in their intelligence quotients than the pupils of the eighth grade. These comparisons are best shown by the accompanying Figures 4 and 5 in which the dotted lines

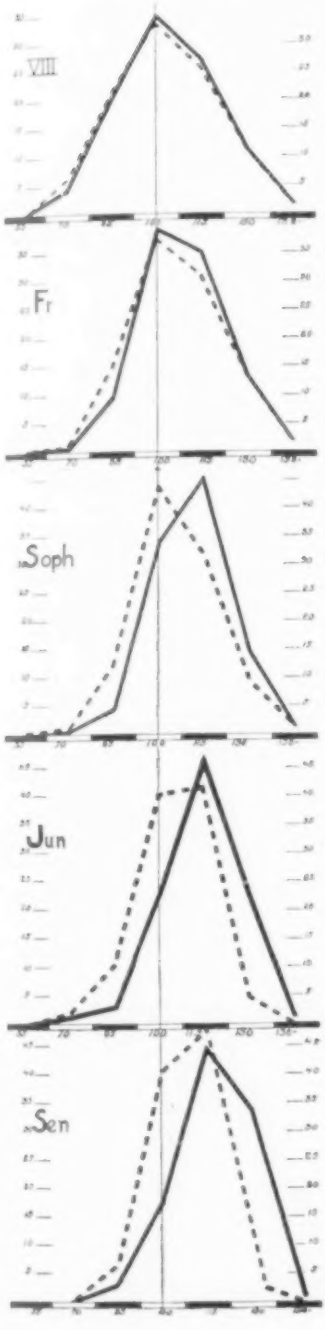

FIGURE 4. I.Q. DISTRIBUTIONS BY AGE IN THREE MASSACHUSETTS TOWNS. SERIES II REVISED. FULL-LINE CURVES RESULT FROM TAKING ADULT AGE AS 14 YEARS AND 6 MONTHS. BROKEN LINES SHOW RESULTS FROM TAKING ADULT AGE AS 16 YEARS.

show the distributions of I.Q.'s by the usual method and the continuous lines by the proposed method.

The findings of Proctor with the Army Alpha, by presumably the usual basis of calculation, are of interest by way of comparison. He finds the median I.Q. of the first year high to be

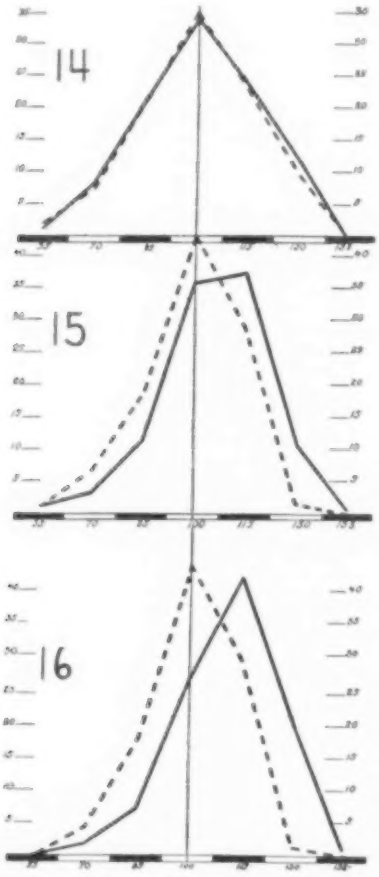

FIGURE 5. I.Q. DISTRIBUTION BY GRADES IN THREE MASSACHUSETTS TOWNS. SERIES II REVISED. FULL-LINE CURVES RESULT FROM TAKING ADULT AGE AS 14 YEARS AND 6 MONTHS. BROKEN LINES SHOW RESULTS FROM TAKING ADULT AGE AS 16 YEARS

105, of high-school graduates 111, and of those going to college 116,[11] and adds that "if the same process of selection takes place in college that we have shown in high school we should expect the median I.Q. of college graduates to be 120 or over."[12]

The tests used in this study[13] have also been applied to a number of undergraduates and graduate classes at Harvard University with the following results calculated on the proposed basis:

Class composed chiefly of freshmen	(54 cases)	I.Q. 125
Classes of upper-class men	(80 cases)	I.Q. 133
Classes of graduate students	(120 cases)	I.Q. 137

Conclusions

Evidence has been presented which shows that the average adult mental age is approximately 14½ years and that the calculation of the intelligence quotients on this basis gives results in closer agreement with established facts than by the method in current use. The conclusions of this study are believed to be more reliable than those based on the Army Alpha and Binet tests, because the tests used in the study are better suited to the purpose, the main groups studied more representative, and the conditions under which the tests were taken fairer for the comparison than in the case of the Army testing. A method is presented in the appendix for the calculation of the intelligence quotients of individuals who are superior to the average adult.

Appendix

Method of Translating Adult Test Scores into Intelligence Quotients

The intelligence quotients, which are obtained by the following method, express the relative brightness of individuals who are superior to the average adult in the same way and have the same value as those obtained below this level by dividing the mental age by the chronological age of the individual. The method has the advantage of using the same index of brightness for adults as for children, and will be particularly

[11] *Op. cit.*, p. 22.

[12] *Op. cit.*, p. 59.

[13] In these classes old Series II (General Examinations 4 and 5) was used.

useful in studying such problems as the constancy of intelligence quotients, where it is desirable to compare the relative brightness of individuals during the period of growth and after maturity.

For purposes of illustration the method is applied to the scores of the thirteen- and fourteen-year-olds of the three communities which are described in the body of this article and which are believed to be fairly "average" of typical communities. The thirteen-year group includes all children in these towns between the ages of 13-0 and 13-11 inclusive with the exception of a very small number in private schools and a negligible number of children of very low mentality. The latter group is somewhat selected because of the elimination from school of a slightly larger proportion of pupils of inferior intelligence than of superior intelligence. If the tests used are valid measures, the average of the latter groups has reached maturity.

The median score of the thirteen-year-olds in the revised Series II of the writer's group tests of intelligence is 85. A pupil securing this score is considered, following the usual practice, to have a mental age of thirteen and a half years. The median score of the fourteen-year-olds is 98.8. The score established as standard for mental age fourteen and one-half years is a little lower, namely 97, because, as just noted, this group is somewhat selected. The mental age standards up to and including age 14 have thus been established by the median accomplishments in the tests of representative groups of the various chronological ages. It is not possible, however, by this latter method to establish mental ages beyond 14, because, as argued in the body of this report, the median scores of unselected groups of ages 15 and above do not seem to advance above the median of the fourteen-year-olds.

It is possible, however, to fix upon points in the distribution of scores above the fourteen-year median which have the same value and significance as the mental ages below this median. These points or scores may, for convenience, be designated as mental ages 15, 16, etc., and the latter may be used to calculate the intelligence quotients of individuals who are superior in intelligence to the average adult or median fourteen-year intelligence.

In the following presentation of the method these intelligence quotients are determined directly from the scores in the tests. It is equally feasible to obtain first the mental age equivalents to the scores and then figure the intelligence quotients from them.

The distributions of the scores of both the thirteen- and fourteen-year-olds are approximately symmetrical, as is indicated in Table VI. The difference between the median and the 25-percentile is, in the case of the scores of the thirteen-year-olds, 21.95. This difference or distance along the base line of the distribution is designated in the following discussion as "— Q". The difference between the median and the 75-percentile is 22.02. This difference is designated as "+ Q." In the case of the 14-year-olds "— Q" = 20.85 and "+ Q" = 19.40.

TABLE VI

	13 Year Distributions		14 Year Distributions	
	Score	I. Q.	Score	I. Q.
Median	85.10	100.5	98.81	101.8
25-Percentiles	63.15	86.7	77.96	90.0
75-Percentiles	107.12	(?)	118.21	(?)
—Q	21.95	13.8	20.85	11.8
+Q	22.02	(?)	19.40	(?)

The problem, as indicated by the question marks in Table VI, is to determine the "+ Q" distances and the 75-percentiles of the I.Q. distributions.

The intelligence quotients of all the thirteen-year-olds who secured scores equivalent to mental ages up to and including 14½ were first calculated by using the standards given in Table I of the foregoing article. Since the intelligence quotients of individuals having scores over that equivalent to mental age 14½ are all well over 100 (the lowest is above 103.6), they are placed above this point in the frequency distribution and the median I.Q. and the 25-percentile of the I.Q. found. The median I.Q., as given in the above table, is 100.5; the 25-percentile is 86.7; "— Q" therefore equals 13.8.

It can now be shown that for a chronological age of 13½ a score below the median can be directly translated into an intelligence quotient by taking the same "Q" location on the two distributions and that the result is the same as it secured when the intelligence quotients are calculated by reference to the standards of Table I. (It may be noted again that the standards below age 13 are based on the median scores of different groups of pupils than the one now under discussion, namely, children of ages 7 to 12 inclusive.) Since there is this correspondence *below* the medians of the two distributions, and, since the distribution of *scores* above the median has practically the same variability as that below, it is fair to assume that the intelligence quotients above the median would also correspond in the same ways to the scores.

The following examples will illustrate the above statements:

A score of 63 in these tests is equivalent, according to the standards of Table I, to a mental age of 11 years, 8 months, and, for a thirteen and a half-year-old, to an I.Q. of 86. This score, as may be seen from Table VI, is at the 25-percentile point of the distribution of thirteen-year-old scores. The corresponding (25-percentile) point of the I.Q. distribution is 86.

The 75-percentile score is 107. Since this score is by the percentile count as much above the median as 63 is below the median, it should have for its equivalent an I.Q. as much above the median I.Q. as 86 is below it, namely 14 points, or 114. The 75-percentile point of the I.Q.

distribution may be secured by adding the amount of "—Q" to the *median* of the thirteen-year intelligence quotients. This is done on the assumption that, since the distribution of *scores* is approximately symmetrical and "—Q" of the scores practically equals "+ Q" (scores), the upper half of the intelligence quotients is also similarly distributed, and that, therefore, "+ Q" of the I.Q. distribution (which is unknown) would equal "—Q" of this distribution (which is known). "—Q" of the thirteen-year I.Q. distribution is 13.8 which, added to the median (100.5), gives 114.3. This, to repeat, is, as was required, as much above the median in I.Q. points as 86 is below it.

When, as in the fourteen-year-old distribution of scores, "+ Q" differs from "— Q" (the distribution of scores not being quite as symmetrical as in the above case), close approximation to the measure of the variability of the intelligence quotients above the median, or "+ Q", may be secured by taking the amount which $\frac{+Q}{-Q}$ of the distribution of scores is of "— Q" of the distribution of intelligence quotients. In the case of the fourteen-year-olds (See Table VIII) this is as follows:

$$\frac{19.40}{20.85} \times 11.8 = 10.97 = \text{"+ Q"}.$$

This correction has been made use of in Table VIII. In Table VII, "— Q" and "+ Q" are taken to be equal.

We may now equate all the scores and I.Q.'s of the lower half of each distribution by successively subtracting these quartile ranges (or fractions thereof) from their respective medians until the lower limits of the distributions are reached. The *points* on these distributions thus found are for convenience designated as — 1Q, — 2Q, — 3Q, — 3.5Q. As a check on the method, the intelligence quotients which have been calculated from the standard mental age equivalents of the scores are also given. This comparison is made in the upper half of Table VII. As will be seen the results are practically the same by either method. The scores and I.Q.'s corresponding to the intermediate points between — 1Q and — 2Q, between — 2Q and — 3Q, etc., may be equated by taking equal fractions of the respective Q distances.

The I.Q. equivalents of the scores above the median may be found by successively adding the quartile ranges or fractions therof to the respective medians. These are designated in the Table, + 1Q, + 2Q, + 3Q, + 3.45Q. The last point equals the maximum score on the tests of 171. The figures are given in the lower half of Table VII. The maximum score of 171, an I.Q. of 148, and for age 13.5 a "mental age" of 20, are as much superior to the median performance for this age as a score of 8, an I.Q. of 52, and a mental age of 7 are inferior to this median.

TABLE VII. I.Q. EQUIVALENTS OF TEST SCORES OF AGE 13½

	By Q. Method		By Age-Score Standards		
	Scores	I. Q.	Scores	M. A.	I. Q.
−1Q	63	86.7	63	11-8	86
−2Q	41	72.9	41	9-10	73
−3Q	19	59.1	19	7-11	59
−3.5Q	8	52.2	8	7-0	52
+1Q	117	114.3			
+2Q	139	128.1			
+3Q	161	141.9			
+3.45Q	171	148.1			

(Median Score= 85. ;—Q=22. ; +Q=22.
Median I.Q. =100.5;—Q=13.8; +Q=13.8)

The same methods and comparisons for age 14 are shown in Table VIII. The "+ Q" of the I.Q. distribution has been taken according to the above calculation as equal to 10.9. The I.Q.'s according to the age-score standards are about one point lower than by the Q method. As noted the fourteen-year-olds studied are a somewhat selected group, the check by method B would be exact if the median I.Q. were taken at 100.8 instead of 101.8.

TABLE VIII. I.Q. EQUIVALENTS OF TEST SCORES OF AGE 14½

	By Q. Method		By Age-Score Standards		
	Scores	I. Q.	Scores	M. A.	I. Q.
−1Q	78	90	78	12-11	89
−2Q	57	78.2	57	11-2	77
−3Q	36	66.4	36	9-5	65
−3.5Q	27	60.5	27	8-8	60
+1Q	118	112.7			
+2Q	138	123.6			
+3Q	157	134.5			
+3.5Q	167	139.9			
+3.72Q	171	142.3			

(Median Score= 98.8; —Q=20.8; +Q=19.4
Median I.Q. =101.8; —Q=11.8; +Q=10.9)

ADJUSTMENTS IN CALIFORNIA[1]

WILL C. WOOD
State Superintendent of Public Instruction, Sacramento, California

In appearing before you this afternoon I feel like one who deals in faith appearing before a group of diagnosticians.

As Superintendent of Public Instruction during the last few years it has been my business to renew people's faith in education. I must congratulate the State of California on the number of people in this meeting today. Something has happened in California in recent years. Ten years ago if we had gotten twenty people together at a voluntary conference like this we would have considered ourselves very fortunate indeed. There has been an educational awakening and I believe it is the most hopeful thing we have in California—the fact that people recognize there is something beyond what we now know that we want to know about.

Our educational program has been sold in California quite successfully. The people of California have shown by a tremendous majority that they desire to keep the schools on a proper basis. As I go through the state addressing various groups of business men, I find them greatly interested in education; they still believe what we sold them is worth while. However the time is coming when we shall have to prove we are "delivering the goods" and if we cannot prove it, we shall find that the advance we think we have made has not been a real advance after all. How are we going to prove that we can "deliver the goods" or that we are going to "deliver the goods"? It is important that we measure the goods that are being offered in California today. If we can measure the goods and prove to the people we are delivering full measure, then, indeed, we can hold to our educational program and our salesmanship will have justified itself.

Last year ten percent of the boys and girls enrolled in the elementary schools of California were repeaters. Over seventy mil-

[1]Address delivered May 30, 1922, before the Conference on Educational Research and Guidance at San Jose, California.

lion dollars was spent on education in California last year. Ten percent of this seventy million dollars was spent on re-education of repeaters. I am convinced we shall have to find some way of cutting down the number of repeaters when the tax payers begin to examine our work more carefully. Is it necessary to have ten percent of our young people each year repeat their work? Our tests should be able to throw some light on the problem of repeaters. I am inclined to think two percent of the repeating may be due to feeblemindedness; I am wondering about the remaining eight percent. Why are they repeaters? Somebody engaged in educational measurements will have to tell us why.

Tax payers, when they get around to it, will also inquire why we have many classes of only twenty-five pupils in our California schools. Why shouldn't we have forty pupils? Some cities have fifty; others have only twenty-five. Why the difference? We shall have to be able to prove it is economical to have classes of twenty-five or the tax payers will draw conclusions that there is waste. How many pupils can a teacher handle successfully? Again educational tests ought to be able to throw some light on this problem.

We are paying salaries in California that justify a fairly long school term. Should the school term be three hundred, or two hundred, or a hundred and sixty days? Someone should be able to tell us how long the school term should be. Then again, how long should the school day be? Should it be six hours or five hours or three hours? Educational tests when properly developed should be able to throw some light on such administrative problems.

Certainly there is an ideal arrangement concerning these matters I have mentioned. Who will define the ideal? The way is open to any enthusiastic student of education to devise tests that will help answer these questions.

We hear of the efficiency or inefficiency of one-room country schools; also of the efficiency of consolidated schools. Do consolidated schools show better results than the one-room school? Tests ought to throw light on this problem. If we can prove

better results in the consolidated school, the problem of consolidation will be simplified. Just now when we go out to sell a consolidation program to a community we have to deal too much in theory and promise.

Should we have supervision in the rural-school districts? City schools have supervision. Some say there is too much. Are we wasting money on supervision in cities? Does supervision pay? If so, how much? Some of these educational testers should find out and let us know. If we are going to have rural-school supervision and retain city supervision it will be necessary for us to prove results.

Shall we teach penmanship one-half hour a day for three days a week or shall we teach it fifteen minutes a day for five days a week? I wish you would let me know. After one has attained a certain degree of efficiency in penmanship isn't he a good enough penman to be let alone? Doesn't the law of diminishing returns apply in penmanship just as it does in agriculture? After a pupil has attained a mark of seventy or eighty on Ayres' scale shouldn't we let him stop practicing writing and put the time in on something else? We want our educational testers to tell us something about this problem.

Can you prove that we shouldn't have grammar in the seventh and eighth grades and thus meet the criticism of high-school teachers who are demanding it for admission to high school? Can you not throw light on the problem when the study of formal grammar should begin? Can you prove that time spent in oral language is well spent?

Then there is the question of county examinations. I think if we had a bureau of educational tests properly organized we could prove that county examinations are not worth while and are not real tests of merit. Until we can prove their lack of worth, until we can find something that will demonstrate that these examinations do not really test, school people will continue to have faith in them.

Educational testers will also have to help us in the administration of the Teacher Tenure Law. A permanent teacher cannot

be dismissed in California except for immoral or unprofessional conduct, incompetence, evident unfitness for teaching, or persistent violation of or refusal to obey the school laws. How are you going to prove incompetency without some kind of a test for teachers? My own belief is that the Teacher Tenure Law will be repealed at the behest of public opinion unless someone finds a means of testing the competency of teachers.

I wish someone would devise a scheme for measuring the ability of music teachers. They come to us asking for certification with all sorts of training—usually taken under some individual from Russia or England or some other foreign land. We have never heard of the instructor under whom the applicant trained. When we attempt to rate the qualifications and find them insufficient, the candidate invariably says it is a case of a layman passing judgment on an artist. I do wish someone would provide us with a means for testing abilities of artists. We should find someone who can tell us what is the value of music in education; also what is the value of the training that teachers of music are given.

We have a law providing that physical education shall be given a certain amount of time each week. We have had it since 1917. Is it worth while? Someone should be able to tell us whether results in physical education justify the expenditure for that purpose. I told the physical education people at their last meeting if we are to continue giving the time required by law to physical education, they must find some way of proving that the time is valuable in results. We are spending over $2,000,000 a year for physical education in California. Are we getting results? We can't take physical education on faith all the time. Someone said the other day that university students are stronger since we adopted our physical education program; but how much stronger? We ask the testers to tell us.

Now as to textbooks, isn't there some way of measuring the desirability of textbooks for elementary schools? I believe it can be done. We have to measure them now but our measurements are necessarily crude. We find many who say the

geography we have adopted is a splendid book. We find others who say it is an atrocious text. Which opinion is right? It is time for us to find some way of measuring the value of texts.

We need tests of buildings and equipment as Professor Hart indicated here this morning. Certainly you would agree with me in this statement if you were to visit some of the rural schools I have visited recently. The county superintendents have no satisfactory standard with which to measure buildings and grounds. We ought to be give them such a standard. Professor Williams has told us of his plan for measuring homes. Won't someone make a standard for measuring school buildings and grounds, and schools as social institutions?

I have mentioned a few things that should be done in the line of measurements in California. I hope there will be other conferences of this kind so I have told you of a few things we would like to have you study. We have made a good beginning in California. We have our city bureaus and one or two counties are engaged in something in the way of measurements; we also have our university bureaus at Stanford and the University of California; we have our teachers' college research centers. Somebody said to me the other day, "What we need is a great central state bureau that will send out people to do the measuring." I do not think so. I do not believe in building up a great bureaucracy at Sacramento. I believe in stimulating local centers to do for themselves what they ought to do. Instead of having dozens of supervisors going out from Sacramento, covering the ground once in three or four years, I would have supervisors and research workers in counties and cities and teacher-training institutions. If the state tries to do research and supervision on a large scale and covers the ground, it will keep counties and cities out of the field. Because the work is so gigantic, the state would do it very poorly if it attempted it. I should like to see every county employ an agent whose business it would be to conduct educational measurements. However, we should need to have a state leader whose business it would be to serve the places which are not served by local people—someone to sell the idea of

measurements to county superintendents, to gather results of observations and measurements, and to provide a clearing house where data gathered throughout the state might be presented to the advantage of others who are working on the same problem. The Sacramento center in the state office would not be a big center; it would be a stimulating center—a directing center. Until we can do this we shall not be able fully to carry out the great program we have undertaken in California.

I am glad to be with you and I am sorry I cannot tell you much about adjustments. I must content myself by telling you what some of the problems are. I think the work in which you are engaged is a wonderful work. I expect it to serve education by showing the people some of the things in the school system that are wrong and by assisting us to remedy them. I also expect your work to serve the school system by indicating to the people that the work we are doing in other respects is worth while; that the amount of money they are putting into education is bringing results commensurate with the amount they are spending. This, I believe, is one of the best ways in which educational measurement may serve the schools of our state.

A COMPARISON OF THE ACHIEVEMENT OF HIGH SCHOOL AND UNIVERSITY STUDENTS IN CERTAIN TASKS IN CHEMISTRY

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Near the close of the school year of 1919-1920, a test of ability to perform the more or less mechanical operations of chemistry was given to a large number of high-school and university students. Twenty high schools participated, fourteen being in medium or small Minnesota cities and the remaining six being outside of Minnesota. Two groups of university freshmen were represented: (1) those who had taken one year of chemistry in the university, but who had not taken chemistry in high school; and (2) those who had taken one year of chemistry in the University and who, in addition, had offered chemistry as an entrance subject. The first group consisting of 57 students is designated in the tables below as U_1, the second group (168 students) is designated as U_2[1]. Table I shows the number of schools which used the test and the number of students who took it.

TABLE I. NUMBER OF SCHOOLS USING THE TEST AND NUMBER OF STUDENTS WHO TOOK IT

	SCHOOLS	STUDENTS
HIGH SCHOOLS	20	731
U_1	1	57
U_2	1	168

The nature of the test is made clear from the following illustrations. These were the directions for each of the eight divisions just as they were printed on the test. Each division consisted of either five, ten, or twenty different items. All the items in a given division were of the same general nature but for the

[1] The U_2 group had had qualitative analysis, the U_1 group had had only one year of general chemistry.

sake of brevity only one item from each is included in the illustrations. The complete test consisted of 95 items.

Illustrations:

1. Write the names of the following substances:
   HgO. (Ten compounds constitute this division.)
2. Write the formula for the following substances:
   Potassium carbonate. (Ten substances constitute this division.)
3. The valence of the following elements and radicals are as indicated. Write the formula for the oxide, bromide, sulfate, and phosphate of each metal.
   Mg^{++}, O^{--} (The valence of five positive and four negative radicals are given and space left for 20 formulas.)
4. Arrange the following elements in order of the activity series: (Ten positive elements are given and 10 blanks provided for arranging them in series.)
5. Place a letter E before each substance listed here if it is an element or a letter M if it is a mixture or a letter C if it is a compound. (The names of 20 substances are given.)
6. Fill in the right-hand side and balance each of the following equations: HgO (heated). (Ten chemical changes are given.)
7. Write the equation for each of the following changes:
   The preparation of oxygen from potassium chlorate. (Ten chemical changes are given.)
8. Write one equation to illustrate each of the following types of reactions: Simple addition. (Five types of equations are asked for.)

The results from this testing furnish data which are valuable in at least four particulars. (1) They show very definitely the difference between the ability of high-school and university students to do certain specific tasks. Both the U_1 group and the high-school group had taken chemistry for one year. These data are, therefore, significant criteria for judging the relative efficacy of the instruction in chemistry in high schools and in freshman classes. (2) It is possible to compare the effectiveness of instruction given in small and large high schools. (3) The high-school data are important because the test was taken by such a large number of high-school students that the scores on each of the items may be considered fairly reliable standards for high schools of the types tested. (4) A basis is afforded for judging the adaptability of the subject-matter to the ability of high-school students. If students generally fail on tasks which have been

included in their instruction we may well question whether those tasks are adapted to the ability of the students. When it is found that as many as 75 percent of high-school students are unable to do a certain task, one of two conclusions are inevitable: either (a) the instruction on that task has been poorly given, or (b) the task is too difficult. If it should be found that both the high-school and university groups are unable to do a task upon which they have received instruction, this fact would furnish an additional basis for questioning the appropriateness of the given task.

Comparison of University Freshmen and High-School Students

The data in the tables below show the amount of overlapping in different schools. Table II shows the median and quartile scores,[2] and the range of scores for all high schools taken collectively. It gives the scores for those schools which ranked, on the basis of medians, as first (highest), second, fifth, tenth, fifteenth, eighteenth, and twentieth (lowest). It also gives the scores for the two university groups. Data from Table II are charted in Figure 1.

TABLE II. MEDIANS, QUARTILES, AND RANGES OF SCORES MADE BY VARIOUS SCHOOL GROUPS

	Lowest	First Quartile	Median	Third Quartile	Highest	Cases
U_2	32	60.8	68.6	76.2	94	158
U_1	39	62.8	66.9	71.8	85	57
H. S.—Highest	33	61.2	67.5	74.5	90	38
Second	33	51.0	64.6	71.0	79	24
Fifth	45	54.5	60.5	65.0	74	14
Tenth	25	46.5	56.1	65.1	81	31
Fifteenth	21	32.0	49.5	53.5	69	27
Eighteenth	17	31.0	45.0	62.0	74	32
Lowest	16	26.0	36.0	49.0	57	8
All H. S.	5	40.5	53.8	64.4	91	731

[2] Score as used in this paper means total number of items done correctly.

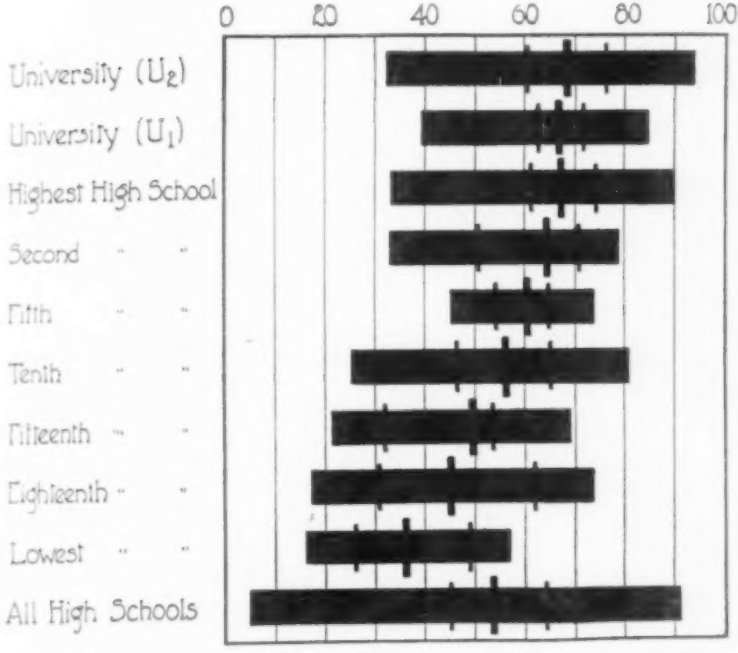

FIGURE I. MEDIAN, QUARTILES, AND RANGES OF SCORES MADE BY VARIOUS SCHOOL GROUPS. (CHARTED FROM DATA IN TABLE II.)

It is clear at once that there is an enormous overlapping of high-school and university-freshmen scores. Note that the median score for the highest high school is actually higher than the median score for the university freshmen who had not had high-school chemistry. Note also that the second high school scored nearly as high as this university group and that down even to the fifth high school the differences in the median scores is inconsiderable.

Table III shows the average percent of scores made on the eight divisions of the test by the same schools as are reported in Table II. Notice in this table that the scores for the highest high school on the fourth and seventh divisions of the test is higher than for either of the university groups. In the first, fourth,

TABLE III. AVERAGE PERCENT SCORES ON EACH OF THE EIGHT DIVISIONS OF THE TEST

	1	2	3	4	5	6	7	8	Cases
U_2.....	86.4	67.2	95.1	34.9	78.6	60.0	44.9	70.8	168
U_1.....	83.2	51.2	95.8	54.8	78.6	52.5	33.7	65.2	157
H.S.–Highest	84.2	43.7	82.0	73.6	80.5	53.0	50.9	63.2	38
Second....	77.0	57.0	89.0	10.0	76.4	56.2	44.2	66.6	24
Fifth.....	75.7	62.9	95.3	8.6	74.6	57.1	31.4	52.8	14
Tenth.....	70.3	37.4	72.0	54.0	76.1	43.5	25.2	36.0	31
Fifteenth...	72.2	40.7	51.6	8.8	68.5	39.6	24.8	48.6	27
Eighteenth..	71.6	34.0	58.0	30.0	69.3	30.6	19.4	31.2	32
Lowest.....	61.3	25.0	46.2	15.0	53.1	33.7	10.0	7.5	8
Average 20 H.S...	70.5	44.0	73.7	35.2	68.8	42.3	27.3	45.6	731

fifth, and seventh divisions, the highest high-school scores are higher than for the U_1 group. The university groups score considerably higher on all divisions of the test than the average of all high schools. The university group which had had high-school chemistry scored higher than the other university group on six of the eight divisions of the test.

Table IV shows the percent of all high-school students who did correctly each of the tasks in divisions 1, 2, 5, 6, and 7 of the test.[3] It also shows the percent correct for the students in the high school which scored highest, and the percent correct for the students in each university group. This table is read: 60.5 percent of all high-school students, 97.3 percent of the students in the high school which scored highest, 89.5 percent of the U_1 group, and 60.0 percent of the U_2 group wrote correctly the name for HgO. This table makes possible a detailed comparison of the differences in the scores made by these four groups. The differences on nearly all items are of the same order of magnitude. There are scarcely any items in the test which

[3]Data from the third, fourth, and eighth divisions were not adapted for such analysis as is given in this table. These divisions are therefore omitted.

TABLE IV. PERCENT OF STUDENTS IN EACH GROUP WHO DID EACH TASK CORRECTLY IN DIVISIONS 1, 2, 5, 6, AND 7

Tasks in Divisions 1, 2, 5, 6, and 7	Percent Answering Correctly			
	Total High Schools	Highest High School	U_1	U_2
1. Write the name of compounds from given formula				
HgO	60.5	97.3	89.5	60.0
MnO_2	86.6	97.3	98.2	97.6
$CuSO_4$	93.1	100.0	100.0	98.2
$ZnCl_2$	97.7	100.0	100.0	98.2
$NaOH$	98.1	89.5*	96.5	98.2
$AgNO_3$	89.2	100.0	100.0	98.8
K_2SO_3	39.7	63.1	86.0	82.7
$SbCl_3$	47.8	57.9	59.6	90.0
H_2SO_3	69.8	81.6	58.0	86.9
$KClO_3$	22.0	55.2	44.0	53.5
Average	70.5	84.2	83.2	86.4
2. Write formulas from names of substances				
potassium carbonate	48.6	31.6	66.6	76.2
ferric chloride	38.1	21.0	15.8	80.0
sodium sulfate	60.0	50.0	75.4	85.1
calcium oxide	84.0	79.0	87.6	90.6
silver sulfide	21.9	15.8	28.0	45.3
potassium iodide	78.5	89.5	94.7	97.6
stannic chloride	9.0	15.8	12.2	25.6
ferrous chloride	37.9	39.5	40.3	78.0
chlorine	49.3	79.0	84.2	48.2
arsenious sulfide	12.3	15.8	7.0	45.3
Average	44.0	43.7	51.2	67.2
5. Classification of elements, compounds, and mixtures				
cane sugar	78.2	84.2	96.5	88.1
table salt	82.5	89.5	100.0	95.2
iron	90.1	100.0	96.5	82.1
brass	43.5	65.8	61.4	72.0
quick-lime	76.4	73.1	94.7	90.0
coal gas	52.7	76.3	33.3	51.9
air	79.3	94.7	96.5	86.3
ink	67.8	84.2	72.0	67.8
plaster of paris	70.5	79.0	42.1	68.4
ether	58.9	76.3	93.0	86.3
baking soda	78.9	76.3	98.2	91.8
ammonia	79.5	89.5	89.5	76.2
arsenic	72.5	86.9	93.0	95.2
carbon	88.3	100.0	100.0	96.4
graphite	52.0	81.6	70.1	67.2
glass	42.0	42.1	17.5	34.5
acetylene	64.7	76.3	93.0	87.5
radium	86.4	100.0	94.7	97.0
paint	84.6	92.1	79.0	87.5
steel	26.2	42.1	50.8	50.7
Average	68.8	80.5	78.6	78.6

*The percents for the "Highest High School" are occasionally less than those for all high schools combined. For example, in writing the name of the compound NaOH, the general percent for high schools was 98.1, while the percent for the school which in general did better than any other (and which is therefore called the Highest High School) was only 89.5.

TABLE IV (*Continued*)

Tasks in Divisions 1, 2, 5, 6, and 7	Percent Answering Correctly			
	Total High Schools	Highest High School	U_1	U_2
6. Complete equations				
HgO (heated)	54.0	87.5	86.0	75.6
$Zn+H_2SO_4$	83.9	97.3	100.0	97.6
$CuO+H_2$	83.5	84.2	94.7	87.5
$Cu+AgNO_3$	24.0	18.4	22.8	44.7
$Fe+Cl_2$	5.4	5.3	0.0	9.5
$KOH+H_2SO_4$	63.5	79.0	80.7	93.4
$Pb(NO_3)_2+H_2S$	70.1	81.6	75.4	91.8
$Cu+H_2SO_4$	12.8	36.8	15.8	27.4
$H_2S+H_2S_x$	16.4	10.6	31.6	33.9
$NH_3+H_2SO_4$	9.4	29.6	17.5	38.7
Average	42.3	53.0	52.4	60.0
7. Write the equations for given chemical changes				
The preparation of oxygen from potassium chlorate	33.3	63.2	31.6	32.7
Burning of hydrogen in air	40.6	79.0	65.0	49.4
Action of sodium upon water	37.1	76.3	52.5	55.3
Preparation of chlorine from manganese dioxide and hydrochloric acid	15.5	49.7	3.5	16.1
Preparation of hydrogen chloride from sulfuric acid and salt	58.5	73.1	77.2	85.1
Test for carbon dioxide	21.2	28.9	22.8	29.4
Laboratory preparation of hydrogen sulfide	24.3	65.8	24.6	53.1
Test for sulfate radical	13.5	28.9	24.6	60.6
Laboratory preparation of ammonia using ammonium chloride	8.7	14.8	12.3	19.6
The action of sulfuric acid on sodium sulfite	20.2	28.9	22.8	47.6
Average	27.3	50.9	33.7	44.9

are especially easy for one group and especially difficult for another. The correlation coefficient (Pearson formula) derived by correlating the percent scores for all high-school students with the percent scores for the students in the U_1 group (column 1 with column 3, Table IV) is 0.84 ± 0.03. The order of difficulty of the tasks for the high-school and the university students is therefore nearly the same.

Tables II, III, and IV show that the difference in the ability of high-school and university students to do the tasks included

therefore called the Highest High School) was only 89.5.

in this test is not very great. They show in fact that the students in at least one high school excel the students who have had their training in university classes.[4]

Comparison of Different High Schools

This material makes it possible to compare the ability of students who have received their training in small high schools with the ability of those who have received their training in larger schools. Students in large schools seem to do somewhat better. Table V shows the relation between size of school measured in terms of number of students taking chemistry and the median scores. The table is read: one school enrolling between 6 and 10 students in chemistry made a median score between 36 and 40; one made a median score between 51 and 55; and one made a score between 56 and 60. The correlation (rank-difference method) between the number of students enrolled in chemistry and the median scores for the different schools is + 0.58.

TABLE V. RELATION BETWEEN NUMBER OF STUDENTS ENROLLED IN CHEMISTRY AND MEDIAN SCORES FOR ALL HIGH SCHOOLS TAKING THE TEST

Number of Students	Median Scores							
	36–40	41–45	46–50	51–55	56–60	61–65	66–67.5	Total
6–10	1			1	1			3
11–15		1	1		1			3
16–20				2				2
21–25				1		1		2
26–30			1		1			2
31–40		1			1	1	1	4
41–171		1			3			4
Total	1	3	2	4	7	2	1	20

[4] A study, not yet completed, of ability of students in a selected list of high schools in large cities to do these tasks seems to indicate that students in these selected schools quite commonly excel the students who have received their training in university freshmen classes.

The statement is sometimes made that students enrolled in smaller classes derive an advantage. No support is found in this study for such a statement. Only two of the schools with 15 students or less in chemistry scored up to the mode. Eight of the fifteen schools with more than 15 students in chemistry scored at or above the mode. Eleven of the twenty schools scored between 51 and 60.

The order of difficulty of the tasks in the first, second, fifth, sixth, and seventh divisions for the students in large and small high schools is nearly the same. The percent of the students in the four largest high schools and the percent of the students in the remaining sixteen schools which did each task correctly were separately calculated. The correlation coefficient (Pearson formula) for the relation between the scores made by the students in the four large high schools and the scores made by the students in the sixteen remaining schools is 0.89 ± 0.02.

Adaptability of Subject Matter

Students commonly believe that chemistry is a difficult subject. Studies seem to show that this tradition has become so well established that students of poor ability have a decided tendency to avoid it. This study makes it possible to locate some of the points which cause difficulty. Table III shows that the scores on the second, sixth, and seventh divisions of the test were consistently low for all groups. The second division is a test of ability to write the formulas for given substances; the sixth is a test of ability to complete equations when the right-hand member is given; and the seventh is a test of ability to write complete equations for given chemical changes. Barely half of the responses made to these tasks by the students in the high school which scored the highest were correct. The average score for all high-school students on these three divisions is well under 50 percent. Of these three divisions the seventh is considerably the most difficult. The average score on this division for all students is scarcely more than 25 percent and the average score for the students in the lowest school is but 10 percent.

Table IV shows in detail the items which caused difficulty. In the second division the formulas for calcium oxide and potassium iodide were the easiest ones to write. In each of these compounds the valence of the positive and negative radicals are equal. The valence of the positive and negative radicals of each of the seven other compounds are unequal. The high-school student should be much more familiar with sodium sulfate than with potassium iodide yet a much smaller percent of students are able to write its formula correctly. From such analysis as the foregoing it is possible to make a definite diagnosis of some of the difficulties which high-school students have with chemistry. The low scores for stannic chloride and arsenious sulfide are no doubt due to the fact that these substances are rather unusual in the high-school laboratory.

The difficulties in the sixth division may be located in a similar manner. In the second item ($Zn + H_2SO_4$) the student is only required to put Zn in place of H_2 and the equation is correct. Similarly in the third item he is only required to put H_2 in place of Cu. All other tasks in this division involve some complications. The low score on the eighth item ($Cu + H_2SO_4$) cannot be explained by saying that it is unusual. Nearly all students have had the reaction of this equation as a part of laboratory work and it is described in all textbooks. Since seven-eighths of the students were unable to do this task it is clear either that the instruction on this item is poorly given or that the item is ill-adapted to the ability of high-school students. In a similar way in the seventh division it would seem either that most of the instruction covering such items as these is poorly done or that the items are ill-adapted to the ability of the students. The scores for all groups on certain items of the sixth and seventh divisions are so low that they furnish evidence in support of the second of these hypotheses. If this second hypothesis is a fact these data furnish an excellent scientific basis for the revision of high-school textbooks.[5] The teacher with these data before

[5]The procedure for establishing the one or the other of these hypotheses is clear and such investigation is now under way.

him must choose one of two possible courses: either he must increase the emphasis on these tasks in his instruction or he must eliminate them from his course. Certainly there can be no justification for giving instruction in any material when upwards of 80 or 90 percent of the students are failing to learn it.

The high-school students made very satisfactory scores on the first, third, and fifth divisions. These divisions were respectively, (1) ability to write the names for given formulas, (3) ability to construct formulas from given radicals and their valence, and (5) ability to classify elements, mixtures, and compounds. Those items in the first division which were missed by the most students are somewhat unusual and in some cases of the nature of catch questions. In the fifth division the most common error was that of classifying mixtures as compounds. Probably the largest value of this test material is its value for testing the adaptability of the subject-matter. These data are computed from the results of testing 731 high-school students. It is safe to conclude therefore that these findings are fairly representative of what may be expected from the types of schools in which these students were enrolled.

Conclusions

1. The difference between students who have taken chemistry in university freshman classes and those who have taken chemistry in the better high schools in ability to do the tasks included in this test is small.

2. Students who have taken chemistry in large high schools do considerably better on the items included in this test than those of the small high schools.

3. High-school students score comparatively high in ability to write the names of compounds from given formulas (division 1); to write formulas from given radicals and their valence (division 3); and to classify elements, mixtures, and compounds (division 5). The lowest scores were on the seventh division which is a test of ability to write the complete equation for given chemical changes. Scores on the second division, which is a test

of ability to write the formula for given substances, and on the sixth division, which is a test of ability to complete equations, were also low.

4. The high-school scores for each of the items of the first, second, fifth, sixth, and seventh divisions of the test are based upon such a large number of cases that the scores on these items may be considered fairly reliable standards for schools of the types represented.

Editorials

If educational service bureaus are to retain, and in some cases regain, the good will of teachers and the respect of superintendents, it is imperative that they subordinate testing to other more vital problems of education. There has been need for the formulation and administration of standard educational and mental tests which without doubt will continue to enjoy increasing usefulness. But well-informed and sympathetic school people are increasingly apprehensive of the danger to the intangible spiritual values of education from over-emphasis upon the testing of the mechanical content of subjects.

Educational tests are rapidly becoming a most potent formalizing factor in public education. They lead teachers to think that success is judged by the use of standard tests on the mechanical phases of instruction, and when teachers think this they necessarily emphasize those aspects of instruction which yield promotion and recognition.

The cure is to be found, not in the abolition of tests by educational service bureaus, but in the development of other interests which will overshadow this essentially minor agency of instruction.

These new major interests should lie close to the firing line. Teachers need help in such activities as methods of instruction, the collection of materials, and the formulation of curricula. Teachers will be greatly aided by difficulty analyses of discipline, and of the teaching of subjects, projects, and ideals. They are clamoring for expert methods of handling these practical difficulties and those who collect them to distribute to the teaching force will earn appreciation and respect.

The time has arrived for the Educational Research Association to put on a broad and vigorous campaign to subordinate the

discovery of how well a teacher teaches to the task of helping him to teach better. It is the function of tests to reveal defects; but it is the duty of service to correct them.

W. W. C.

A CHALLENGE

While many research workers are dealing with the minutiae of measurement, the school people are confronting larger problems and seeking light upon them. It is possible so to magnify the importance of detail—the fine points of method and the calibration of instruments—as to lose sight of vital and fundamental issues. Individual differences exist among research workers as in every human group. Some are purists, enslaved by the rigid requirements of a hypertrophied technique. If by chance they stray beyond the orbit by which they are habitually circumscribed, they are afraid they are about to fall off the edge of the world.

To such as these State Superintendent Wood of California administers, though quite unintentionally, a stinging rebuke. We are privileged to present in another part of this issue of the Journal his admirable address given last May before the Conference on Educational Research and Guidance at the San Jose State Teachers College. We are glad to bring his message to the attention of a larger audience than that which heard him on that occasion. For what he says is indeed timely. It is a challenge and an inspiration.

For example, California has a teacher-tenure law; and according to this law the only way the schools may be relieved of weak teachers is to prove their incompetency. Such laws are being passed in many places. The larger cities of the country where many teachers combine to secure legislation have such laws. The theory behind these laws is sound. They are faulty, however, in their administration. The trouble lies in the fact that incompetency cannot be proved. Superintendent Wood says the research workers must devise a method of rating teachers that will "stand up." The time will come when the teacher-tenure

laws will be repealed unless they can be administered so as to protect the schools from the incubus of inefficient teachers.

In one city employing about fifteen thousand teachers it is reported that in a certain year only thirteen teachers were dropped from the service because they were rated unsatisfactory. It is incredible that among fifteen thousand teachers less than one-tenth of one percent should be incompetent. What effect this practically universal approval of the services of teachers has upon the morale of the force can only be estimated. That a large number of teachers put forth unusual effort when their colleagues may drift through the year with the same assurance of position and salary is indeed a tribute to the teaching profession.

We have not meant to draw the reader's attention particularly to the rating of teachers as an issue in educational research. There are hundreds of other major problems. Some of them, such as class size, length of term and length of school day, consolidated versus one-room rural schools, are mentioned by Superintendent Wood. He could easily have made his list much longer.

While, therefore, it is entirely proper that we should refine our methods, we must recognize the call for larger vision. We must not hesitate to grapple with problems which demand solution. Appreciating the limitations of our instruments, we may nevertheless rest assured that they are far better than those which are in general use. Consider, for example, the futility of the recent investigation on the part of the teachers of a certain city concerning the value of the all-year-round school. The only real conclusion which this so-called investigation warrants is that the teachers do not want to teach in the summer. Much is said about "social and economic considerations" and the fact that they preclude effective school work in the summer months; but everyone who is so unfortunate as to have to contribute to the work of the world in the summer time knows how fraudulent these representations are.

Counsels of perfection, therefore, on the part of research workers, extended to the "control of all the variables" and to

the third decimal place of reliability determinations, may be pressed too far. The decision in regard to grave issues would then be left to those whose lack of any scientfic method, to say nothing of their personal bias, will make them totally unfit for the task. It is well enough in the proper place to be meticulously careful; but to strain at gnats while swallowing camels is proverbially foolish.

B. R. B.

Reviews and Abstracts

BOBBITT, FRANKLIN. *Curriculum-making in Los Angeles.* (Supplementary Educational Monographs, No. 20, June, 1922.) Chicago: University of Chicago Press, 1922. 106 pp.

Professor Bobbitt and the high-school teachers of Los Angeles have undertaken a gigantic task in re-examining the curriculum according to methods described in the monograph "Curriculum-Making in Los Angeles."

To the work Professor Bobbitt brought a comprehensive list of over five hundred "human abilities and characteristics" which was prepared with great patience in his classes in University of Chicago by several hundred experienced teachers who worked under his direction. This list was presented to committees of the twelve hundred junior and senior high-school teachers of Los Angeles who used them as a starting point to determine the "human abilities and characteristics which appear to be generally needed by citizens of Los Angeles." Committees formulated a list of objectives for each of the following subjects and groups of subjects: the social studies (history, social geography, economics, and civics), mathematics, the biological sciences, the physical sciences, physical training, home occupations, practical acts for boys, visual art, music, English expression, modern languages, and Latin. To illustrate, the objectives of musical training finally arrived at are: (1) a mind enriched with the auditory imagery of the great music of the world; (2) ability—as auditor or musical "consumer"—judiciously to utilize music for healthful, abundant, and varied awakening of one's emotional nature; (3) ability, disposition, and habit of participating in home, chorus, or community singing. Note: For those relatively few who go on to higher levels of production, other objectives should be added to the above.

When these have been determined, a set of general assumptions or hypotheses is utilized in formulating the pupil activities by which the objec-

tives are to be realized. Specifically, in music there are twenty-eight hypotheses which will guide the music teachers of Los Angeles in the teaching of music. Some of the hypotheses are: "(1) For the sake of normal training for appreciation, music of proper quality should enter abundantly into the general *life of* the school. (2) Home player-pianos and phonographs will be utilized for training in musical appreciation as fully as practicable. (3) In the main, for non-performers, music is a thing to be *experienced*, not a thing to be *studied*. (4) Pupils should be made reasonably familiar—so far as ability permits—with the criteria to be employed in judging the worth of music. (5) The Seashore tests should be used in classifying pupils for musical training. (6) The fundamental experience in learning to sing is, of course, to sing. A maximum of time should be given to this with accessory training reduced to the necessary minimum."

The monograph thus deals with two problems—the selection of objectives for subjects and the principles of selection of means by which the objectives are to be accomplished. It does not discuss the resulting content of the subjects.

This study represents a serious and significant attack upon the problems of curriculum construction and is a distinct contribution to the field in two respects. It presents by long odds the most complete sets of objectives and methods of realizing them that have yet been published; and it illustrates and develops consensus as a tool in curriculum construction.

A careful study of the investigation prompts this observation. The venture bulks so large and appears so complicated that it constitutes a strong argument for great research agencies which have ample time, means, and facilities to devote to such studies of the curriculum. It is impracticable for voluntary organizations of teachers in service to carry the task much beyond the point to which it has already been taken.

W. W. CHARTERS

Carnegie Institute of Technology

THOMAS, F. W. *Training for effective study.* New York: Houghton Mifflin Company, 1922. 246 pp.

In this volume, as is pointed out by the editor of the series in which it appears, the emphasis is shifted "from the recitation itself to the preparation for the recitation, from the accumulation of knowledge to learning how to find and use knowledge, from the gathering of information to learning how to use it and hence stand on one's own feet, from drill to appreciation and expression, from learning facts to fitting for responsibilities, and from discipline by rules to training for rational self-control" (p. VIII). It is a mode of approach which, in the judgment of the editor, "could displace, with advantage, much of the special-methods work now given to intending teachers" (p. IX).

The author approaches his task in the conviction that our present-day conceptions of teaching have not, as yet, effected an appropriate revision of methods of studying. We emphasize the need of cultivating independent thinking, but we neglect the application of this view to the process of pre-

paring for the recitation. After pointing out how wrong teaching, the traditional type of examination, and slovenliness in making assignments may foster slavish dependence upon the textbook, the author proceeds to the discussion of the remedies. These fall under the following chapter heads: knowing what is to be studied, having a motive for study, securing continued application, and effective methods of study, such as memorizing, drill work, collecting and organizing information, and solving problems. The final chapter is devoted to the supervision of study, and discusses the physical conditions of study, the use of reference books, the correlation between recitation and study supervision, and other pertinent topics. Each chapter is concluded with a set of suggestive questions for study.

The book is a real contribution. It is clear and simple in style, and offers much useful material. The author knows his ground and handles his subject effectively. Perhaps the most serious defect of the volume is its treatment of problem-solving. As the author himself says, "In a broad sense, the greater part of school work should be connected with the solving of problems" (p. 189). Yet this topic, strangely enough, is dismissed with six scant and formal pages, and the topic of collecting and organizing information is considered without any intimate reference to the solving of problems. It is difficult to see how the aim of "growth in independent self-direction and skill in study" is to bear proper fruit unless more attention is given to this topic, which lies somewhere near the center of the whole subject.

B. H. Bode

Ohio State University

Kline, Linus Ward, and Carey, Gertrude L. *A measuring scale for freehand drawing. Part I: Representation.* Baltimore: The Johns Hopkins Press, 1922. 61 pp.

Part I of "A Measuring Scale for Freehand Drawing" by Linus Ward Kline and Gertrude L. Carey, edited by Edward Buchner (being number five of a series of Studies in Education from the press of the Johns Hopkins University), covers the subject of representative drawing. It is an interesting review of a careful study of children's drawings gathered from schools in various parts of the country. These drawings were made under certain conditions on four designated themes for the purpose of establishing a fixed standard by which the progress in pupils' work might be systematically graded.

After a careful analysis, comparison, and grading of the many drawings by unbiased committees, typical drawings were selected and arranged as suggesting a logical development of pupils' abilities in such work. It contains a number of tables of interest to students of a psychological bent.

The report is also illustrated with reproductions of from sixteen to twenty of the selected drawings on each theme. These are so arranged as to offer a key for the scaling of pupil's work.

The resulting scale is intended for use by the pupil as well as the teacher. When used by pupils, it should make for positive growth and development especially along the lines of analysis, perception, and execution. The teacher

will find the scale of value as a standard by which to gauge the success of her pupils either during successive periods of the same year or from grade to grade. The promised publication of the reports on design and color will be looked forward to with interest.

WILLIAM H. VOGEL.
Director, Department of Art, Cincinnati Public Schools

SNEDDEN, DAVID. *Civic education.* Yonkers-on-Hudson: World Book Company, 1922. 333 pp.

The problem of "making democracy safe," which grew out of the turmoil of the World War and out of the world-wide propaganda for revolution, has centered attention strongly upon the need for better training for citizenship. Professor Snedden's book, "Civic Education," is by far the most thoroughgoing and scientific of all the discussions that have grown out of this crisis. In it he brings to bear upon this important question the analytic methods he has made familiar to us in other applications, but gives many more constructive suggestions than he customarily has done.

In Part I he gives concrete and practical "suggestions to teachers" on the objectives of civic education and materials and methods for attaining them. In Part II he retraces some of the same ground but discusses in a more technical way the sociological meaning of education, the meaning of social education, society's need of civic education, the objectives of civic education, and education for democracy. In Part III he discusses chiefly the problem of methods for finding the objectives of civic education. He favors the method of "type-group" analysis, with which the readers of his "Sociological Determination of Educational Objectives" and his recent journal articles are already familiar. As examples Professor Snedden gives eleven representative type-group studies made by his seminar. These not only illustrate the method but are themselves suggestive through their content. He also has a chapter which gives teachers some very sane guiding principles on the knotty problem of "freedom of teaching in the social sciences" (reprinted from *School and Society*).

The book does not expose some nostrum with the claim that it is a panacea for all our ills. Primarily, it is a challenge to clear and definite thinking about the objectives of civic education and about the means and methods for realizing these objectives. The author would have the educator determine, by sociological methods, what are the threatened civic deficiencies of particular groups of individuals, translate these into very specific educational objectives, and then, unfettered by tradition, search out procedures that would forestall these threatened deficiencies. He expects comparatively little from accidental transfers from school discipline, general moral precepts, or even from history, but much from developmental readings, problems, and projects that are so controlled as to clarify ideas and motivate acts and attitudes specifically related to citizenship.

The major theses of the book are not new to close readers of Professor Snedden's works. However, they are worked out with a wealth of detailed suggestions that justifies anyone, even though already familiar with the view-

points, in following them through. To those teachers of the social sciences who are not familiar with Professor Snedden's work the book should come as a revelation. Its sanity, definiteness, and hard-headed common sense are in marked contrast with the vagueness and utopianism of most discussions of the subject. The reader must not, however, expect concrete accounts of method devices. These are left to the teacher to work out. For example, in a rather large section devoted to the possibilities of teaching through problems and projects, long lists of possible exercises are proposed but the actual working out of no one of them is described.

The following seem to the reviewer to be weak points in the volume.

1. It is somewhat fragmentary in make-up. It gives one the impression of having been thrown together from materials prepared for other purposes. Indeed, a number of sections are taken almost bodily from Professor Snedden's other published works. This fragmentariness makes it more difficult to follow through than if it were conceived and executed as a unit.

2. One is embarrassed by the very wealth of its suggestions and problems. It rushes on from one problem to another with such rapidity as to overwhelm one. The book might have been made more valuable to ninety percent of the teachers who will read it if fewer things had been said and these few developed at greater length.

3. While the method of prognoses of type-group deficiencies (made by from one to five judges uncontrolled by any count of cases) is a big step in advance of the crude thinking to which we have been accustomed, it can not be considered a really scientific method. It opens the gate too widely to the easy generalizer. Methods of research in this field must—and can—be worked out that are more objective, more systematic, and more successful in eliminating the personal equation of the investigator.

CHARLES C. PETERS

Ohio Wesleyan

RHODES, CHARLES E. *Effective expression.* Chicago: Gregg Publishing Company, 1921. 532 pp.

A good many teachers are of the opinion that the study and practice of English would not suffer in the least if the publication of books on rhetoric and composition should be prohibited for a decade. Such a damming of the stream is not likely to occur; and it is only fair to say that Charles E. Rhodes goes far toward justifying his own contribution in the form of a volume called "Effective Expression."

Here is a text planned to cover the four years of the high-school course and perhaps the first year of college work. Its range is unusually complete, its arrangement sensible, its material almost superabundant. If one should say that the book contains little which might not be found elsewhere, one would say only what applies to almost every text on high-school and college composition published since Barrett Wendall wrote his English Composition, or since Scott and Denney broke ground for the study of the paragraph.

What "Effective Expression" accomplishes is the presentation, in a way both interesting and manageable, of almost all the principles and forms of expression, written and oral. The collection and organization of material is carefully attended to, with the teacher in mind as well as the student. Mr. Rhodes is old-fashioned enough to believe that the basic principles of rhetoric must be mastered by the student of composition, and has a good deal to say of those abiding qualities, clearness, force, and elegance. His chapter on diction will commend itself to the teacher who must labor with the awkwardness and vulgarity that beset the boy and girl in written and oral work alike. This section is one of the best, admirably direct and simple, yet remarkably complete in its survey.

Another excellent chapter is that on letter writing. It manages to include a brief historical introduction, a comprehensive study of letter forms, plenty of models, and an extended list of exercises.

The study of the paragraph is conventional in treatment, but presents excellent illustrative material. The chapter on oral composition would gain by elaboration of such a helpful section as that on kinds of speeches, and a briefer treatment of matters of poise, vocalization, modulation, and the like, regarding which an observant teacher could easily guide and correct pupils.

There is a lively discussion of narrative writing with especially fresh material relating to dramatization of poems and stories and to the preparation of pageants. High-school teachers will welcome the helps supplied in this section, as well as the suggestive exercises at the end of the chapters on narration and description.

"Effective Expression" presents an adequate treatment of exposition and argumentation, handled in accepted fashion. The chapter on exposition emphasizes notably such special forms of this kind of writing as the exposition of a story and the exposition of character; it contains an interesting section on book reviewing, with plenty of examples; and it suggests helpful plans for the expository composition. Under argumentation one finds serviceable discussion of the debate, with extended explanation of the brief, and many exercises.

Finally, there appears a useful compendium of material on the composition of verse forms.

W. L. GRAVES

Ohio State University

MORRISON, JOHN CAYCE. *The legal status of the city school superintendent.* Baltimore: Warwick and York, 1922. 162 pp.

A good piece of research work always commands the attention of serious students, and to some extent, also, that of the general public. On the basis of this truism one may without hazard predict an extended sale of "The Legal Status of the City School Superintendent" by John Cayce Morrison. It adduces a vast amount of evidence bearing upon a phase of educational organization known to be in a confused state, and shows the extent to which the confusion really exists. The book also brings to light certain things per-

taining to the office of city superintendent that seem to be working in the most satisfactory way.

The evidence gathered and subjected to analysis in the course of Mr. Morrison's study comes from four general sources: (1) historical writings; (2) statutes of the various states, and city charters and codes; (3) judgments of lay and professional leaders in education; and (4) general principles of government. The first of these yields relatively little on so modern a phase of educational development. The second constitutes the author's main reliance. The third is considerably developed, although to no great profit, considering the lack of any marked degree of consensus among the replies regarding most of the matters submitted, and the inconclusive value of such consensus in so far as it does obtain. The chapter, dealing with the last type of evidence, is in reality a well-reasoned argument in support of the author's conclusions.

Mr. Morrison's study represents a vast searching of the laws, and his results in this field are of outstanding value. Some of the more noteworthy conditions here revealed are: the practical disappearance of ward representation in boards of education; the predominance of small boards of from five to seven members, and the election by popular vote for a four-year term of office; an almost universal vesting of the boards of education, either expressly or by implication, with the power both to elect and to remove the superintendent; and a prevailing term of office for the superintendent of four years. The study shows that the general advisory function of the superintendent is a matter of established custom rather than of express legal provision. The powers with respect to which the superintendent is most nearly independent of board control, whether in cities operating under general legislation, or otherwise, are: the enforcement of attendance; granting of working papers; the making of formal reports; and the supervision of classroom instruction. The extent, however, to which this last power is expressly conferred by law is surprisingly limited. The office of superintendent obtains an exceptionally large measure of recognition in the state code of Delaware. Kentucky is also a rather conspicuous state in this respect. Well-constructed tables, rather basely treated by the printers, however, occur throughout the text. These show the results of combining in various ways the original data, detailed tabulation of which is furnished on supplementary sheets contained in a cover envelope. The code for interpretation of these tables should have been printed on the same sheets as the tables themselves rather than in the book proper. The extent of defects in this study of the office of the superintendent of schools is by no means such as to affect at all seriously the outstanding value of the work.

F. C. LANDSITTELL

Ohio State University

News Items and Communications

This department will contain news items regarding research workers and their activities. It will also serve as a clearing house for more formal communications on similar topics, preferably of not more than five hundred words. These communications will be printed over the signatures of the authors. Address all correspondence concerning this department to Doctor E. J. Ashbaugh, Ohio State University, Columbus, Ohio.

John G. Fowlkes, Ph.D. Columbia, has been appointed assistant professor of education at the University of Wisconsin to give lectures on school administration.

Dr. George W. Frasier has resigned his position as director of classification and statistics in the Denver public schools to become dean of the graduate school and professor of education in the Colorado State Teachers' College at Greeley.

Mr. Ray Lathan, who for some years was superintendent at Le Mars, Iowa, has lately been appointed Director of Research at Duluth, Minnesota.

At Lorain, Ohio, all the junior high-school pupils are being classified as far as administrative restrictions permit on the basis of the results of the Illinois Intelligence Scale given last September. Pupils entering the first grade are also being grouped. The Detroit First Grade Intelligence Test is being used for this purpose. Slow, average, and superior groups are being set up both for the junior high-school and first-grade children.

W. H. Hughes moves pretty fast. Appointed a few months ago to head up the Department of Educational Research at Pasadena, California, he is out with Volume I, Number 1 (dated September 26, 1922), of the Educational Research Bulletin. It is dedicated to the encouragement of the spirit and practice of cooperative research. We feel sure that the Pasadena schools will derive much benefit from the Bulletin. Although essentially local, it will no doubt prove of interest to educational students everywhere. We wish the new Bulletin every success.

Dr. Margaret S. McNaught, for nine years Commissioner of Elementary Education for the State of California, has tendered her resignation to the State Board of Education. She plans to spend several years in Europe.

Previous to accepting the commissionership of elementary education, Dr. McNaught, then Dr. Shallenberger, was for several years professor of psychology at the San Jose State Normal School.

Miss Dora B. Thompson, Assistant Superintendent of Schools, Boise, Idaho, submits a plan for use in determining promotions. It is designed to clarify the ideas of teachers concerning the meaning of the marks they give pupils. A chart of fourteen items constituting the factors which, in the opinion of the school officers, should be in the mind of the teacher in rating the pupil is provided. Ratings in mental ability, in achievement, and in knowledge of subject matter are included.

Doctor May Ayres Burgess, formerly in the Education Department of The Russell Sage Foundation, is now with the Motion Picture Producers and Distributors of America of which Will H. Hays is president. Doctor Burgess is trying to act as an informal liaison official between the motion picture industry and education. She writes that quite a bit of research is likely to be involved and hopes that she may have a part in it.

We have just received Survey Bulletin, No. 2, from Superintendent A. W. Elliott of Mount Vernon, Ohio. This bulletin gives for each class in the elementary schools the average intelligence quotients and the scores at the beginning and end of the year in spelling, reading (Monroe), composition (Willing), and arithmetic (Monroe Reasoning). Very gratifying progress was made between the beginning and end of the year in the abilities measured by these tests. Nevertheless, as usual it is found that "there is a great deal of difference in teaching skill."

The Bureau of Naturalization of the United States Department of Labor has issued a pamphlet entitled "Suggestions for Securing and Holding Attendance of Foreign-Born Adults upon Public-School English and Citizenship Classes" which is extremely interesting and suggestive to all interested in the problems of the foreign born. Not only does it give some extremely practical suggestions concerning the subjects indicated by the title, but it also gives some decidedly good hints regarding the methodology of handling the groups. The teaching devices described are those which have proved successful in many good schools, and are further supplemented by reports, from a number of centers in different parts of the country, which suggest practices demonstrated valuable in specific local situations. The pamphlet can be secured by writing to the Bureau of Naturalization, Washington, D. C.

Miss Myrtle L. Kaufmann, elementary supervisor at Logansport, Indiana, has furnished her teachers with an analysis based on the frequency of use of the phonic elements occurring in the primer used at Logansport. In her bulletin on the subject she says: "It seems reasonable to assume that those sounds which occur most frequently in the early reading vocabulary are the ones which should be taught first. In the first place, they are more easily

taught because they are the most amply illustrated in the child's practical experience with words. In the second place, the fact that they occur often is a guarantee of their frequent use after they are taught."

This practical device of Miss Kaufmann's is in line with her study of the frequency of the appearance of words and phrases—a study which appeared in the June, 1922, number of the *Journal of Educational Method.*

In the *School Index* for September 29 we find the following summary of the enrollments of the Cincinnati schools for the present year:

	1922	*1921*	*Increase*
Elementary	38,012	37,740	272
Special	1,534	1,260	274
High	8,136	7,671	465
Total.	47,682	46,671	1,011

The New York Society for the Experimental Study of Education is moving to organize the Educational Foundation. The purpose of this foundation is to finance scientific studies in education. A large number of men and women prominent not only in educational but in professional and business life have signified their interest.

It is planned to perfect the organization of the foundation during the present school year. A statement emanating from the experimental society points out the need for the foundation in the following words: "Decisions on school questions should not be left to chance. Tradition and opinion should give place to carefully observed and verified facts. But adequate facts are not fully available. There is much need for painstaking, scientific research in education, the type of research that has produced such striking results in the natural sciences and industry."

Miss Nina C. Vandewalker of the Federal Bureau reports that the growth in kindergarten registration from 1918 to 1920 amounted to 37,811 thus raising the percent of kindergarten attendance from ten and one-half percent to eleven. The states which report the largest gains are California, New Jersey, Michigan, Minnesota, Iowa, Massachusetts, and Illinois, in the order named.

Margaret C. Holmes, assistant director of kindergarten in New York City, reports that she and her colleagues are working on two problems as follows: (1) an attempt to measure the relationship between the Detroit Kindergarten Test and the Binet-Simon Test; and (2) an attempt to measure the relationship between the teachers' judgments and the ratings obtained by the use of the Detroit Kindergarten Test. Some work has been done on the first of these problems and the second is well on its way to completion. Ten kindergarten teachers each classified twenty children as advanced, normal, or slow, after an experience with them of about three weeks. The Detroit Test was then given to the same children and they were divided into three groups on the test basis. The agreement between the teachers and the tests in the

classification of the children ranged from 78 percent placed in the same group by teacher number I to 40 percent by teacher number X.

Per Pupil Cost Per Recitation in High-School Subjects

Assistant Superintendent Dawson of Grand Rapids has issued a mimeographed bulletin showing the per pupil recitation cost on various high-school subjects. The range is from 3.7 cents for gymnasium to 14.3 cents for public speaking. The average cost for all subjects is approximately 6.7 cents.

He points out that there are, in general, three causes of differences in cost: (1) the salary of the instructor; (2) the number of periods per week taught by the instructor; (3) the size of classes.

The following regulations control program-making in the Grand Rapids high schools.

1. It is undesirable to form classes with less than fifteen students.
2. For schools having sixty-minute periods, regular academic teachers should teach five periods, manual-training teachers should teach six periods, and laboratory work should be counted in the same manner as manual training.
3. Session-room teachers, with rooms having less than one hundred pupils, should teach four or five periods per day; those having one hundred to two hundred pupils should teach three to four periods per day; and those with rooms having more than two hundred pupils should teach two to three periods per day.
4. In schools having forty-five minute periods, regular academic teachers should teach six periods, manual-training and laboratory, eight periods; and session-room teachers, one period more than in schools having sixty-minute periods.

Mr. Dawson reaches the conclusion that these regulations, which are in accord with those of the North Central Association of Colleges and Secondary Schools, are fundamentally correct and that in the administration of the high schools these regulations should be adhered to in program-making.

He also states that an outstanding feature of the report is the very low per pupil per recitation cost of public school work as compared with private instruction. The inference is that parents should think how much less the cost per child is in the public schools compared with cost of private instruction rather than how large the school budget is as a whole.

Reply to a Criticism of Tests Requiring Alternative Responses

In an article in the October, 1922 issue of the Journal, regarding the reliability of tests requiring alternative responses, Dean Hahn has voiced criticisms which many others may be thinking. It seems important, however, that we should not neglect in such a discussion, to consider certain important relevant facts. In the first place, the best test of any test is correlation with a criterion. If this correlation is satisfactory, we can forget all minor criticisms concerning chance, etc. If we accept with Gates that the best available criterion of success in a course is a composite of all the grades given,

including daily recitations and oral quizzes, special conferences, written papers, and written examinations of various types, then the fact that the true-false test has a higher correlation with this criterion than the conventional examination must be accepted as significant evidence of the validity of this type of test as a measuring device. But even though one denies this criterion, he must choose some other. Dean Hahn tacitly assumes some criterion of achievement. In contending that the conventional examination is better than the true-false he is assuming for the former, better predictive value as measured against this presumably entirely subjective criterion. Nowadays in the light of the evidence, not many are willing to rely on such subjective standards.

In the second place, no one has a right to insist on perfect reliability. The question at issue is "Does this method secure more accurate results than other available methods?" To answer this, the reliability of the true-false method should be compared with that of the conventional method of examination making. Reliability may be defined as the degree to which a test agrees with itself in measuring the same abilities on two or more occasions. While high reliability does not in itself mean that the test measures the abilities we want to measure, nevertheless the significance of the test in that respect is always restricted by the degree of reliability. The unreliability of the ordinary examination is notorious. Reliability coefficients as low as 0.35 have been found. Whatever abilities it is designed to measure, it is clear that such a test as an index of those abilities is vitiated by the intrusion of irrelevant factors which are not constant. Woods has shown that even when the accuracy of the scoring is unusually high, reliability coefficients of only 0.76 and 0.61 were obtained from three-hour examinations in Algebra and Geometry given by the College Entrance Examination Board. These can hardly be considered satisfactory since other forms of tests exist which are more reliable. The newer type of examination used in Columbia University yields a coefficient of 0.90. This includes several types of examination, among which is the true-false. The latter alone has a reliability of 0.80. Toops has found that of three of the newer types of test, namely recall, recognition, and true-false, the latter yields results as reliable as the others for equal amounts of examination time given.

It is in the attempt to eradicate the elements contributing to unreliability that the true-false tests have come into being along with other new examination methods, and not primarily "to avoid trouble in answering questions and scoring answers," although this is a most valuable outcome and not an unworthy argument in favor of such tests. That they have been successful in the attempt to increase reliability and validity has been proved. That they are perfect indices of ability has not been claimed even by their most ardent advocates.

It is true that with the method of scoring used, one assumes that every wrong answer is a guess. It will be guessing unless (a) the pupil has learned the fact erroneously, or (b) the wording of the question is suggestive. Erroneous knowledge may for practical purposes be considered negligible and as to (b) there is as much reason to believe that the pupil has been sug-

gested in the right direction as often as in the wrong. Nor does the supposition that the number of wrong guesses equals the right guesses always work with precise accuracy. But given a sufficiently large number of questions, the effect of this inaccuracy on the total score is negligible. The power of this type of test, to cover in a given time far more ground than the ordinary test can, adds more to its relative reliability than any such inaccuracies can subtract. The ordinary test suffers from the fact that the smaller the number of questions, the greater the effect of chance vitiations.

That alternative-response tests may be so made that they constitute a test of judgment and thought-organization has been demonstrated by Wood. Inability to test the "why" is a criticism of the skill of the test-maker rather than an indictment of the test form.

The question of the pedagogical value of examinations is a pertinent one. It is always necessary to consider the purpose for which any particular test is given. Many forms of tests may have excellent value as teaching devices but at the same time be unreliable indices of students' relative standings. On the other hand, a measuring device need not of necessity be a teaching device. To insist that every test must have value as a teaching instrument is to deny that the measurement of the results of teaching may be legitimately the primary motive for the giving of an examination. As education is administered today, however, the necessity for reliable measuring instruments is apparent.

It is true that any test involving dichotomous responsing is weak as an instrument for diagnosing special individual difficulties, although for general diagnosis it has proved its usefulness. If a test could be devised which would have all the advantages of the true-false and correct for this disadvantage, it would be heartily welcomed.

H. M. BARTHELMESS

Uses of Tests in State Normal School at Ellensburg, Washington

During the first few weeks after entering, students of the State Normal School at Ellensburg, Washington, are given intelligence tests and standardized tests in reading, arithmetic, grammar, geography, and history. These data were worked up by the department of psychology for the use of all departments. Last year the Army Alpha was given, this year the Thurstone test will also be used. Check tests are used in certain cases and specialized tests when possible.

Last year the upper, middle, and lower quartile were found and students were listed in their respective quartiles for both intelligence and educational tests.

In order to make the data easy to read, red circles were placed around those marks falling in the upper quartile, green circles around those marks falling in the lower quartile, or in some educational tests around those falling below the eighth-grade median which was considered standard for normal-school students.

The upper-quartile group and the lower-quartile group present striking appearances and even to the eye the correlation between intelligence rating

and standing in subject matter is obvious. Upper-quartile students show a great predominance of red circles and the lower quartile of green circles.

Those students whose scores in subject matter fall in the lower quartile, or below the eighth- or ninth-grade medians, were assigned to remedial classes or to further work in the subjects in which they were weak.

A definite attempt was made to give those students in the upper quartile opportunity and encouragement for advancement and leadership.

Individuals who showed rather high rating in intelligence but low scores in subject matter were interviewed by the psychologist in an endeavor to get at the reasons for the discrepancy, for purposes of remedying the situation.

Efforts were made to raise the academic standing of those who fell in the lower quartile in both intelligence and subject matter, but little improvement was made. Some of these students were eliminated by repeated failures and others were advised to go into other vocations. It seems that those who rank C and below in the Army Alpha test are not teacher material.

A study of standings in each subject each quarter was also made and curves were plotted of intelligence ratings and markings. Those who were high in intelligence were on the whole rated high in subject matter and those who were low in intelligence were low in subject matter. Some very interesting information was obtained from the teachers' marks; namely, that bright students were working under their ability, average and below-average were working at their best.

As was found in Kirkpatrick's Massachusetts study, we found our teaching directed to the lower and average rather than the upper levels of student ability.

All the scores a student obtains in these examinations are filed permanently on a Teacher Rating Sheet which is used in the appointment office. The result of the physical examination is also placed here. In addition, five qualities thought to be important for teachers are scored by the Scott rating scheme and about twenty points are left for word descriptions.

During the coming year a more elaborate program is contemplated. The high school records will be studied. A personal information card similar to that used at Brown University will be used. The Thurstone as well as the Army Alpha test will be given.

MARY A. GRUPE

Reading Improved Through Tests in Iron Mountain, Michigan

In order to determine the condition of reading in the Iron Mountain public schools, the Burgess Silent Reading Test was given by the supervisors in grades III to VI, inclusive, in January 1921. The results reveal some startling facts. Not only was speed much below standard, but there was a great deficiency in comprehension. In numerous cases children who read with fluency and expression and were considered good readers by the teacher failed completely on this test of comprehension. As a result of a conference between teachers and supervisors the pupils in each room were divided into groups as follows: (1) Group A—those who ranked above standard in both speed and

comprehension; (2) Group B—those who ranked as average readers but needed general help; and (3) Group C—those who ranked below in either speed or comprehension or in both.

Group A did very little, if any, oral reading but spent their time in individual silent reading either for pleasure or for information. They were frequently called upon to report upon what they had read. Group B read daily, the emphasis being divided between speed and comprehension as their needs were recognized. Group C was given added time and attention and a careful study was made of their special difficulties. These groups were very flexible and promotions made in them as progress warranted. This gave much inspiration to the work.

Individual teachers instituted excellent methods of remedial work that were most effective. Prominent among these were the following:

1. Suggestions for decreasing vocalization given in O'Brien's "Silent Reading."

2. Silent reading of a given amount under pressure of time followed by reproduction.

3. Questions upon the blackboard to be answered through study. An illustration taken from a third-grade study of Stevenson's "Land of Story Books":

1. When did it say the lamp was lighted?
2. Where did it say his parents sit?
3. Did they sing and talk?
4. What did he carry with him?
5. Where did the lions come to drink?
6. What kind of camp did he play he was in?
7. Who stopped his play?
8. Has the little boy really been across the sea?
9. Where did he go after play?
10. If you think this little boy liked to play draw a line around play.

4. Pupils frequently prepared their own questions either orally or in writing. Other pupils were called upon to answer these and were encouraged to evaluate the type of question.

5. Studying over a new lesson with the pupils for meaning of words, phrases, idioms, etc., before attempting to read it.

6. Dramatization of interesting stories using characteristic phrases.

7. Continuous analysis of meaning of words through context and use of dictionary. When practicable these words were incorporated into every-day usage.

8. In grade III riddles were composed by teacher and pupils for quick interpretation.

9. Flashing phrases and sentences before pupils for speed in comprehension.

10. Supplementary tests of various kinds were sent from the office and others prepared by teachers frequently to check on individual progress.

This work was not confined to the grades from three to six. The first- and second-grade teachers realized that the real foundation for future good

reading rested with them. They studied the problem as intensively as the others, followed many of the above methods, and were confident that the results would be in evidence next year.

At the close of the year, Picture Supplement No. 2 of the Burgess test was given and a careful comparison of results tabulated. The improvement was most gratifying and showed that a forward step was being taken in the right direction.

Eighty-eight percent of the whole number of pupils increased their speed and there was an improvement in speed of 36 percent.

There was a marked improvement in both accuracy and comprehension as the following table shows:

January Total		June Total	
Right	4549	Right	6867
Wrong	1520	Wrong	1911

Not only do these data prove that definite measurable progress was made but there were many other evidences of improvement. The pupils were able to do more intelligent work in geography and history, use better judgment in selecting material and topics, appreciate literature better, and interpret thought problems in arithmetic much more clearly.

Those directing the work are gratified with the progress made during this short period and expect that with two or three years of this intensive work, reading in the Iron Mountain Schools will have reached a very high standard.[1]

M. B. TRAVIS

Superintendent, Iron Mountain, Michigan

Classification Into Ability Groups In Santa Rosa

Eighty-nine pupils entering junior high school in September 1921 were classified into ability groups on the basis of testing with the National Intelligence Test, Form I, Scales A and B. Those having mental ages one or more years above their chronological ages were placed in VII-A[1] group. Those whose mental ages were one or more years below their chronological ages were placed in VII-A[2] group.

The junior-high teachers were told of the separation into ability groups and it was suggested that more be expected of the VII-A[1] group and less of the VII-A[2] group than of the VII-A[2] group. It was also made clear to the teachers that a recommendation from them for the shifting of pupils from one group to the other would always be considered.

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[1]We do not wish to discourage Superintendent Travis and his teachers, nor minimize the value of the work which they have done on the reading situation. It is but fair, however, to call the readers' attention to the fact that various investigators have found evidence that the Picture Supplement, No. 2, of the Burgess Test is not as difficult as No. 1. An article by Professor Gates of Columbia University which will appear in an early issue of this Journal gives the results of some very careful work along this line. In other words, it is probable that the improvement in the reading situation in Iron Mountain, while significant, is not so great as the figures obtained would seem to indicate.

EDITOR.

During the term one boy and three girls, on the recommendation of their teachers, were shifted from the original grouping. The boy, who had been placed in the VII-A[1] group, was placed in the VII-A[2] and the two girls were placed in the VII-A[2] from the VII-A[3]. It is interesting to note that at the end of the school year two of these three each made a score of 122 in the Terman Group Test. The third had been transferred to another school. However, these pupils seemed to be misfits in the groups in which they were originally placed and so the change was made.

In February, 1922, the VII-A ability groups became VII-B ability groups. There were a few changes in the personnel of the groups owing to transfers from other schools but an effort was made to place all new comers in the group most nearly fitted to their abilities.

In March, 1922, the following tests were used in each of the groups:

1. Terman Group Test.
2. Trabue Language, B and C.
3. Monroe's Silent Reading Test II.
4. Woody-McCall Mixed Fundamentals.
5. Starch's Problems, Scale A.

The median scores obtained were as follows:

	VII-B[1]	VII-B[2]	VII-B[3]
Terman Group	104.5	86.5	62.5
Trabue Language (average B and C)	15.1	14.3	12.7
Woody-McCall	29.0	27.5	27.3
Starch Problems	11.6	10.0	8.9
Monroe's Reading-Rate	133.0	114.0	108.0
Comprehension	35.0	24.3	20.8

In the educational tests the greatest difference in abilities is shown in the reading. Monroe's Test II for Grades VI, VII, and VIII failed to measure the VII-B[1] group and so Monroe's Test III for grades IX, X, XI, XII was used. The score made in this test was so far above the norm for grade VII that it was decided to use this same test with an X-B English class (an unselected group) under as nearly identical conditions as possible. This was done and while the X-B class made a score above the standard for grade X the VII-B group excelled the X-B group in rate 47.7 points, and in comprehension 6.6 points.

In order to check these results, Thorndike's Alpha 2 "Understanding of Sentences" was used and the median score for this VII-B[1] group was equal to Thorndike's standard for grade IX. The results of the tests suggest:

1. That the academic work done by the pupils closely parallel the mental status as indicated by the intelligence tests.

2. If the Woody-McCall norms are not too high, then our seventh grade is weak in the fundamentals of arithmetic.

3. Either the norms of Monroe's Reading Test are too low or our seventh grade has a reading ability which is above the average grade XII student in both rate and comprehension.

4. The type of reading ability that is measured by Monroe has probably been stressed more in our schools than the type measured by Thorndike.

5. The pupils of VII-B^2 and VII-B^3 groups are probably working under conditions fairly well suited to their abilities while in the VII-B^1 group much time is being spent unprofitably.

6. To accommodate the different abilities of our different groups a more elastic program is needed.

M. LOUISE IRVING

Santa Rosa, Cal.

The Retention of Pupils in the Blewett Junior High School

One of the claims made for the junior high school by way of justifying the greater expense, more arduous labor, and disconcerting departure from traditional procedure, incident to the inauguration of the movement, is that the new type of intermediate school will operate to retain its pupils to a degree not accomplished under the former plan. The writer has always been interested in the question of the retention of adolescents in school, and, upon assuming his present position, attempted to discover whether the institution had been living up to its billboards in that respect. He soon found that the question could not be easily answered. In addition to the legitimate snares which attend the use of the statistical devices recommended by Strayer, Thorndike, Ayres, and others for the purpose, there were other complications. The district from which the school was fed had been changed many times. High rents were driving people out of the district. There were three different rates of movement through the course of study, so that pupils who entered with certain other less capable children were later perhaps a year ahead of them in grade. In short, there were so many factors affecting the enrollment at various points that it was impossible to estimate the elimination by comparing the enrollment of the ninth grade with that of the seventh, the enrollment of the ninth with that of the seventh two years ago.

In order that eventually there might be an answer to the question we resorted to the expedient of following the individual pupil from the time of his entrance until he severed his connection with the school in one way or another. A special "Class Registration Card" was devised which enabled the class supervisor to keep check on the individual students through a series of semesters.

When a class of pupils entered from the contributing elementary schools they were divided into advisory groups on the basis of school ability, it being the intention to maintain the integrity of each group throughout the stay of its members in school. Incidentally, it was intended to have the group in charge of the same teacher adviser throughout. The adviser entered the names of the members of the group upon the class register card at once. At the end of each half-year thereafter he made an entry opposite each name to indicate present membership, transfer, withdrawal, etc. A pupil received, by transfer or original entry, was listed at once. These entries were simplified by means of the code of abbreviations.

This began with the class which entered in September, 1920. Now, at the end of two years, we know positively some very definite things about the degree of elimination which has taken place in this school in that time.

In Table I is given a "Statement of Loss and Gain" by way of summary. One half of the table deals with a combination of the two classes

TABLE I. STATEMENT OF LOSS AND GAIN

	Classes Entering			
	Sept. 1920–Nov. 1920		Sept. 1920–Jan. 1922	
Original number at entrance		255		947
Transferred out and by death	55		123[a]	
Transferred in	40		90	
Net loss by transfer		15		33
Net receipts		240		914
Withdrawals, financial reasons	3		3	
Withdrawals, failure	4		6[b]	
Withdrawals, health	3		7	
Withdrawals, cause unknown	3		10	
Withdrawals, gross	13		26	
Re-entered after withdrawal	4		5	
Net loss by withdrawal		9		21
Number remaining, June 1922		231		893
Net loss	9/240 = 3.75%		21/914 = 2.3%	

[a]Loss of one by death
[b]One, "Don't like school"

which entered in September and November, respectively. These two must be studied together, since they were so close together in grading that they became mingled soon after entrance. Since November, 1920, classes have entered only on the half-year. The other half of the table deals with the sum total of all the classes which have entered the seventh grade from September 1920, to January 1922, inclusive. Both these statements are as of June 1922. Later figures are not available as yet.

The writer was astounded when he saw these summaries. Of the 255 pupils who entered in the fall of 1922, less 55 transferred out, plus 40 additions, only nine have "quit school." Sixty-four are ready for tenth-grade work in the senior high school; 66 for the second half of their ninth-grade work; and 101 to begin ninth-grade work. Similarly, of the 947 pupils who have entered the seventh grade since we began to keep these records, plus 90 additions, only 21 have "quit school." It will be noted that while we do not assume responsibility for the present academic status of those who left us to continue their schooling elsewhere, we do assume that responsibility for those who have been received by transfer. It should be further noted that the net loss through the transfer relationship with other schools is the result of the

prevalence of high rents in this district, there having been practically no building in this neighborhood in recent years.

There are two other phases of the elimination question which bear upon the subject. One is the loss in transition from the junior high school to the

TABLE II. STATEMENT OF LOSS IN TRANSITION FROM ELEMENTARY SCHOOLS TO BLEWETT CLASSES ENTERING JANUARY 1922 AND SEPTEMBER 1922

	Class Entering			
	January 1922		September 1922	
Total number finishing elementary schools		229		182
Number not in Blewett district	9		8	
Number who left city	0		14	
Total eligible list		220		160
Number entering private schools		3		5
Net Blewett list		217		155
Number withdrawn because of health	0		2	
Number withdrawn to go to work	1		0	
Number who entered Blewett		216		153

senior. This we cannot know definitely until this time next year. The other is the loss in transition from the elementary school to the junior high school. Table II gives a "Statement of Loss in Transition" which represents studies of the two last entering classes, those of January 1922 and September 1922, which shows that the loss here is negligible.

The reader may draw his own conclusions. It would seem from the above that it is entirely possible for the junior high school to eliminate elimination.

H. H. Ryan

Principal, Blewett Junior High School, St. Louis, Missouri

Educational Research Association

(Frank N. Freeman, *Secretary and Editor*)

Educational Measurements at West Allis

Reported by T. L. Torgerson, Director of Department of Educational Measurements, West Allis

The following extracts are taken from a report of the Department of Educational Measurements of West Allis, Wisconsin. This report, made by Mr. T. L. Torgerson, the director, illustrates the possibilities of such a research department in a small city school system.

Organization and Administration.—The local school system is organized on the six-six plan. The kindergarten and first six grades comprise the elementary schools, and the upper six grades the secondary school or junior-senior high school. A Department of Educational Measurements was organized September 1920 with a director and an assistant in charge.

The results of achievement and intelligence tests supplemented by the teacher's judgment form the basis for promotion in the elementary school. Final examinations begin in the fifth grade. Pupils are classified according to ability. A permanent record is kept of every pupil in the elementary schools giving the results of standard tests. A system of record forms has been devised for this purpose. Every pupil in the elementary and junior high school receives at least one intelligence test every year. The subnormal pupils are segregated and placed under the care of special teachers.

Classification.—Each grade in the junior high school is classified according to ability. The intelligence quotient forms the basis for this classification. Thus each section approximates a homogeneous group and the entire class can be taught as one individual. Irregularities in promotion and administrative

The Table I shows the classification in the junior high school during the past semester.

TABLE I. MEDIAN INTELLIGENCE QUOTIENTS. ILLINOIS GENERAL INTELLIGENCE TEST. FEBRUARY 1922

Sections	Boys	Girls	Both	Number Pupils
VII-B^1.....	88	88	88	18
VII-B^2.....	116	111	114	16
VII-A^1.....	73	78	76	38
VII-A^2.....	82	88	85	38
VII-A^3.....	96	96	96	28
VII-A^4.....	109	109	109	
VII-A^5.....	120	121	121	

difficulties have prevented a strict classification on the part of every pupil. These difficulties will be largely overcome the present year. The same method of classification is carried out in the elementary schools. A small enrollment in some of the schools prevents dividing a grade into sections. In that case the pupils of the room are divided into two groups.

As a result of three semesters of classification in the seventh and eighth grades failures have been reduced from 10 percent to 7 percent. Taking into account the per pupil cost of instruction this factor alone presents a tremendous saving. Of even greater importance is the fact that the pupils are stimulated to more and better work, increased interest, and greater initiative.

Pupil Efficiency or Achievement in Terms of Capacity.[1]—During the past year the department has attempted to determine the efficiency of each pupil in the elementary and junior high schools through the combined use of achievement and intelligence tests. The intelligence level or "capacity for learning" was determined for each pupil by means of intelligence tests, the achievement level by the use of achievement tests. When the two levels approach unity the pupil is considered 100 percent efficient, that is, he is doing all that can be expected of him. In other words a pupil's limitation in ability to master a subject is his intelligence or "capacity for learning" as measured by intelligence tests. A pupil with a low mental level will have a low level of

TABLE II. EFFICIENCY QUOTIENTS IN A THIRD-GRADE READING CLASS BASED UPON THE THORNDIKE-MCCALL READING TEST

Pupil	Efficiency Quotient October	Efficiency Quotient May	Change
1	125	125	0
2	115	105	−10
3	110	100	−10
4	105	100	− 5
5	105	100	− 5
6	105	105	0
7	105	100	− 5
8	100	105	+ 5
9	100	120	+20
10	100	115	+15
11	100	105	+ 5
12	95	100	+ 5
13	95	105	+10
14	95	100	+ 5
15	95	115	+20
16	95	100	+ 5
17	90	115	+25
18	80	95	+15
19	75	105	+30

Median Efficiency Quotient October—100
Median Efficiency Quotient May—105

[1] Torgerson, T. L. "The efficiency quotient as a measure of achievement" *Journal of Educational Research*, 6:25-32; June, 1922.

achievement. If his mental level is high he should have a correspondingly high achievement level. Measuring all pupils by median or average scores in an achievement test results in under-rating the slow pupil and over-rating the superior pupil. A study of the efficiency of the pupils revealed the fact that the superior pupil is the least efficient. The truth of this statement is borne out by Franzen in a similar study. The standard for the West Allis pupils is an efficiency of 100 percent in terms of their own capacity. Table II shows the efficiency quotients of a third-grade class in reading. You will note the improvement in efficiency on the part of every pupil with a low initial efficiency.

Measuring the Results of Instruction.—Improvement in the efficiency of instruction with an ultimate efficiency of 100 percent are two vital objectives for every teacher. The efficiency of a class may be determined at any time by the combined use of achievement and intelligence tests. The improvement in instruction can only be determined by giving the tests at the beginning and at the end of the period in question. During the past year standard tests were given at the beginning and at the end of each semester in spelling and in silent reading.

TABLE III. RESULTS OF STANDARD TESTS

Subject	School	Average Efficiency Quotient		Gain Percent
		October	May	
Silent Reading	Elementary	105	107 5	2 4
Spelling	Elementary	83	94	11 0
Spelling	Junior High	97	100	3 1

Promotion in the Elementary Schools.—What has been the effect of two years of measurement upon the grading and promotion of the pupils of the elementary schools? The results of standard tests offer objective evidence of increased efficiency and higher standards of work. If the promotion rate has remained unchanged the schools have still made desirable progress due to the increased efficiency. The following data give the percent of pupils failing and the percent receiving double promotions in June during the past three years. The record for 1920, the year prior to work in tests and measurements, is given in comparison with the two years since the department has been established.

	Percent		
	1920	1921	1922
Failures	13	14 4	9
Double Promotions	0 8	4 5	2
Net Failures	12 2	9 5	7

The above data show that during the past two years as a result of the work in educational measurements the net failures have been reduced from

12.2 percent to 7 percent. While failures have decreased the standards of work have been raised.

In the elementary school we have aimed to provide for the superior pupils by classification, maximum assignment, and extra promotions. The pupils are placed in grades suited to their mental ability. The slow pupils are given minimum assignment with more drill. Undoubtedly the best way of meeting the problem of individual differences is by organizing the elementary school on a multiple track basis. This system provides a course of study for the slow pupils, another for the average and still another for the superior pupils. Consider the advantage of having a course of study fitted to the needs of each group. Failures are eliminated. All of the pupils complete the elementary school in eight years and they are all happy, since failures, misfits, and the resulting eliminations have been done away. The schools of Oakland, California under the direction of Virgil E. Dickson, Director of Research, are organized on this basis.

In the junior high-school readjustment of the curriculum to conform to the abilities of the various groups was given considerable attention during the past year. It is hoped that progress will be made in this direction during the present year.

A program of this kind will cost no more to administer, on the contrary, it will be more economical as failures will be reduced to a minimum and the cost of instructing the pupils who otherwise repeat their work will be eliminated. The pupils will be kept in school longer because they are given the kind of work which they can do and for which they are fitted. In brief the ultimate result of such a program will be:

1. Keeping the slow pupils in school at least through the junior high school.
2. Reducing elimination of all pupils to a minimum.
3. Reducing failures to a minimum.
4. Elimination of retardation.
5. Reducing the cost of instruction by eliminating repeaters.
6. A program of educational and vocational guidance that will determine the fitness of the individual for a given vocation and direct his training toward the vocation for which he is fitted.
7. Training all pupils to be 100 percent efficient.